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Railway Signaling & Communications

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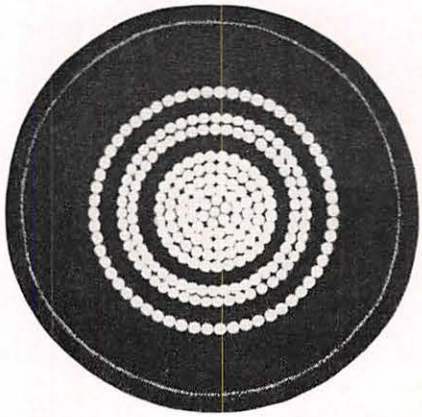

This is a Kerite cable used for essential circuits in the world's first atomic plant at Oak Ridge, Tennessee... *a quarter of a century ago.*

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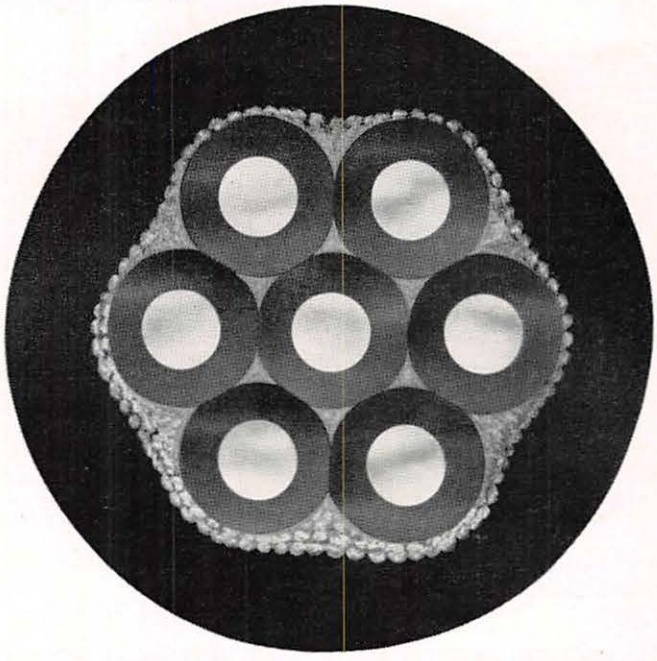

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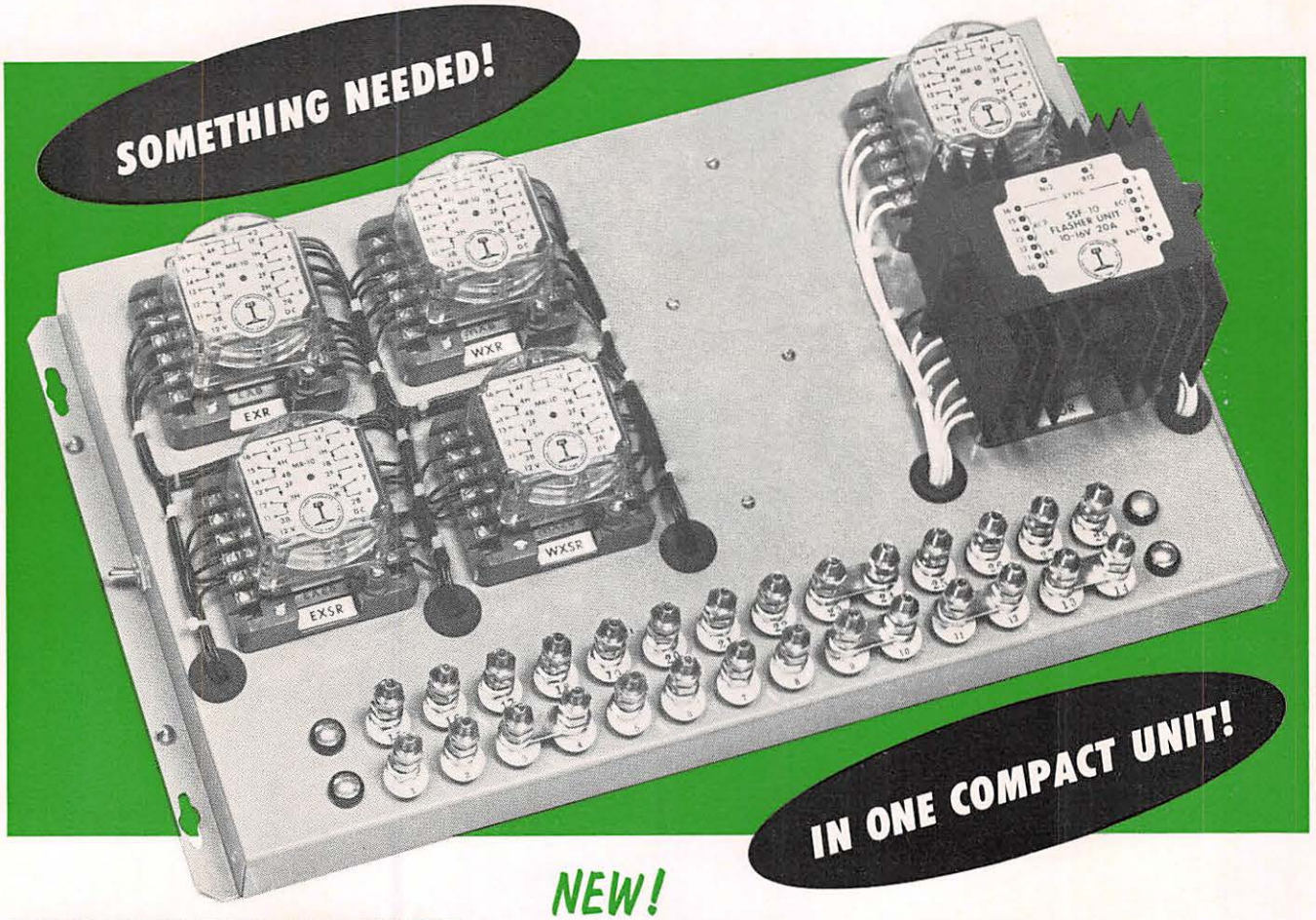

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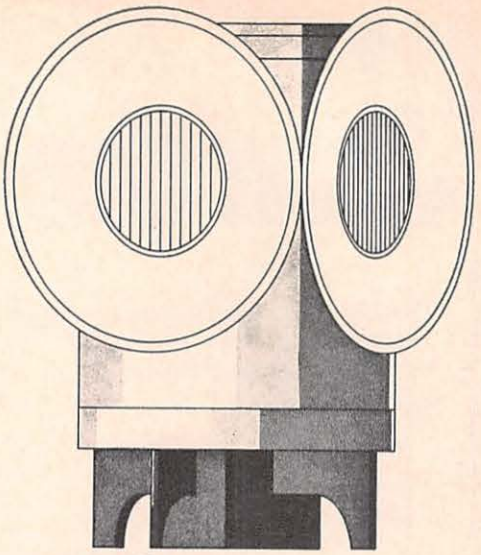

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Circle 4 on reader service card on page 38

February 1969
Vol. 62 No. 2

Railway Signaling & Communications

Railway Cybernetics: Data Concentrators Aid ACI 11

Mobile Printer Operates via VHF Radio 19

C&O Installs Digital Controls for Wayside Radio 23

News Briefs 8

View from the Crossarm 24

Product News 25

Data Sheets 162, 163, and 164: Data Modems 28, 30, 32

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Editor's Corner

Did you know that it is relatively easy to become a signaling and communications expert? If not, just read the trade press, newspapers, speeches by government officials, and reports prepared by many firms (often not involved in S&C endeavors) outlining what's right and what's wrong with today's signaling and communications facilities.

It used to be a standing joke that an expert was a man 50 miles from home, when he sounded off on a subject. Also, there is the comment about the college economics professor: "if you're so smart about the stock market, how come you aren't rich?"

I think there are new requirements for becoming an expert, and it does apply to S&C experts. It is simply not to have been required to work in the field. Also, one must start a project with an open mind, or is it a blank one? (Oops, that slipped out of the typewriter).

What causes this little essay, and its been building for quite a spell, is reading some recent accident reports of the National Transportation Safety Board, plus questions I'm asked by consultants and market research people.

Also, of late, or at least for the last five years or so, it seems that everyone is getting into the signaling and communications act. It's amazing how many railroad managements think of their S&C officers as men in charge of departments that only install that very technical and highly complex equipment used in signaling and communications facilities. Also, many of these same managements blithely take the attitude that when one is contemplating expenditures in this area, one must consult some expert, certainly not the S&C officer. Get the industrial engineers busy, call in consulting engineers, shout for the management consultants or efficiency experts, but don't ever ask the S&C officer.

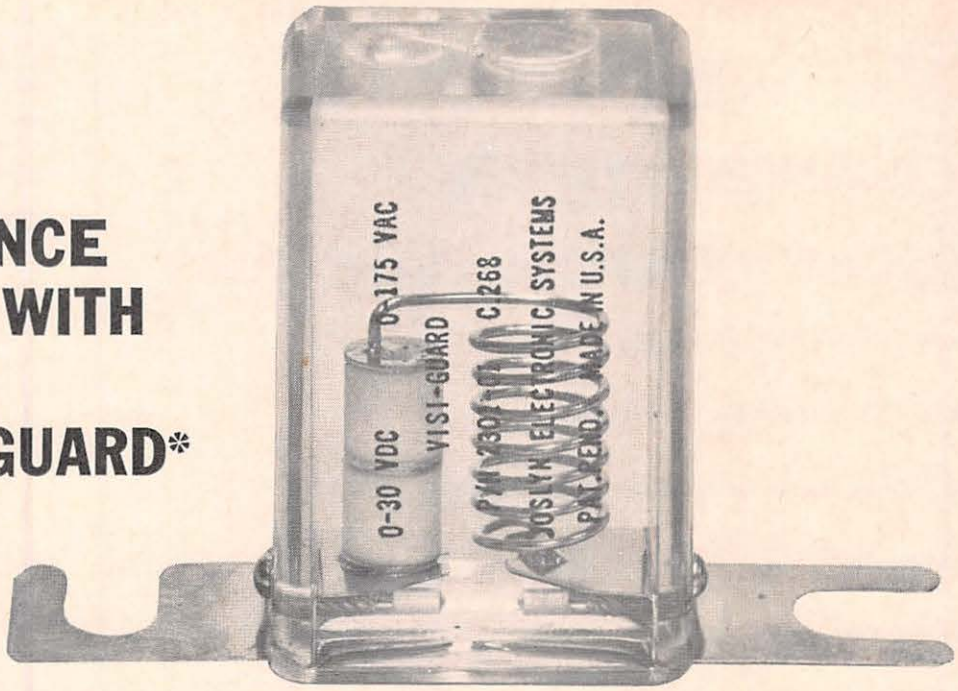
About the only good answer I can come up with is that it is a tremendous selling and educational job that S&C officers must do on their managements. And fortunately, there are some S&C officers who have expended the effort in educating their managements about what they as S&C officers can do for their railroads.

As I've said before, signal and communications officers have the facts at hand, plus the experience to think positively and approach managements with convincing evidence that S&C men can do the job, not the outside experts. It's a big challenge, but one I am sure can be met.

Bob McKnight

P.S. Don't forget to plan to attend the annual meeting of the Communication & Signal Section, AAR, at Montreal, Que., Sept. 16-18, 1969.

NOW– ONE LESS MAINTENANCE PROBLEM WITH JOSLYN'S NEW VISI-GUARD*



How much time and money, maintenance-wise, do false restrictive failures due to transients in the electronics cost you? Chances are, plenty! Worse yet, the problem they cause for you is compounded when you factor in the cost of disrupted schedules.

Now you can virtually eliminate those damaging transients up to 50 times or more every time they hit your electronics! Joslyn's new lightning and electrical signal type surge arrester — the 2300 series VISI-GUARD — protects your signaling equipment against larger surges and more often than any other means you presently may be using.

Breakdown voltage – 500 v peak. Response time as fast as 0.15μs at 10 kv per μs rate-of-rise. A minimum of 50 rated operations each consisting of a 5,000 ampere discharge current (10 x 20μs waveshape) and resulting power-follow current which automatically extinguishes. Another plus feature: extreme duty discharge capacity of 15,000 amperes 10 x 20μs waveshape.

The Josyln VISI-GUARD is dimensionally designed to directly replace existing arresters using any base including the molded plastic base, or AAR porcelain base, or the three-post porcelain base.

The price for protection has to be considered, of course. But if a device doesn't work, why buy it? With VISI-GUARD you know it will work. For that assurance, $8.60 each in quantities of 100 to 299 is low. VISI-GUARD — the device that frees maintainers for other problems. Another quality product in Joslyn's full line of electronic surge protection equipment for electronic systems. Write today for new JES 140 brochure. Joslyn Electronic Systems, Santa Barbara Research Park, P.O. Box 817, Goleta, Calif. 93017. Tel. (805) 968-3551.

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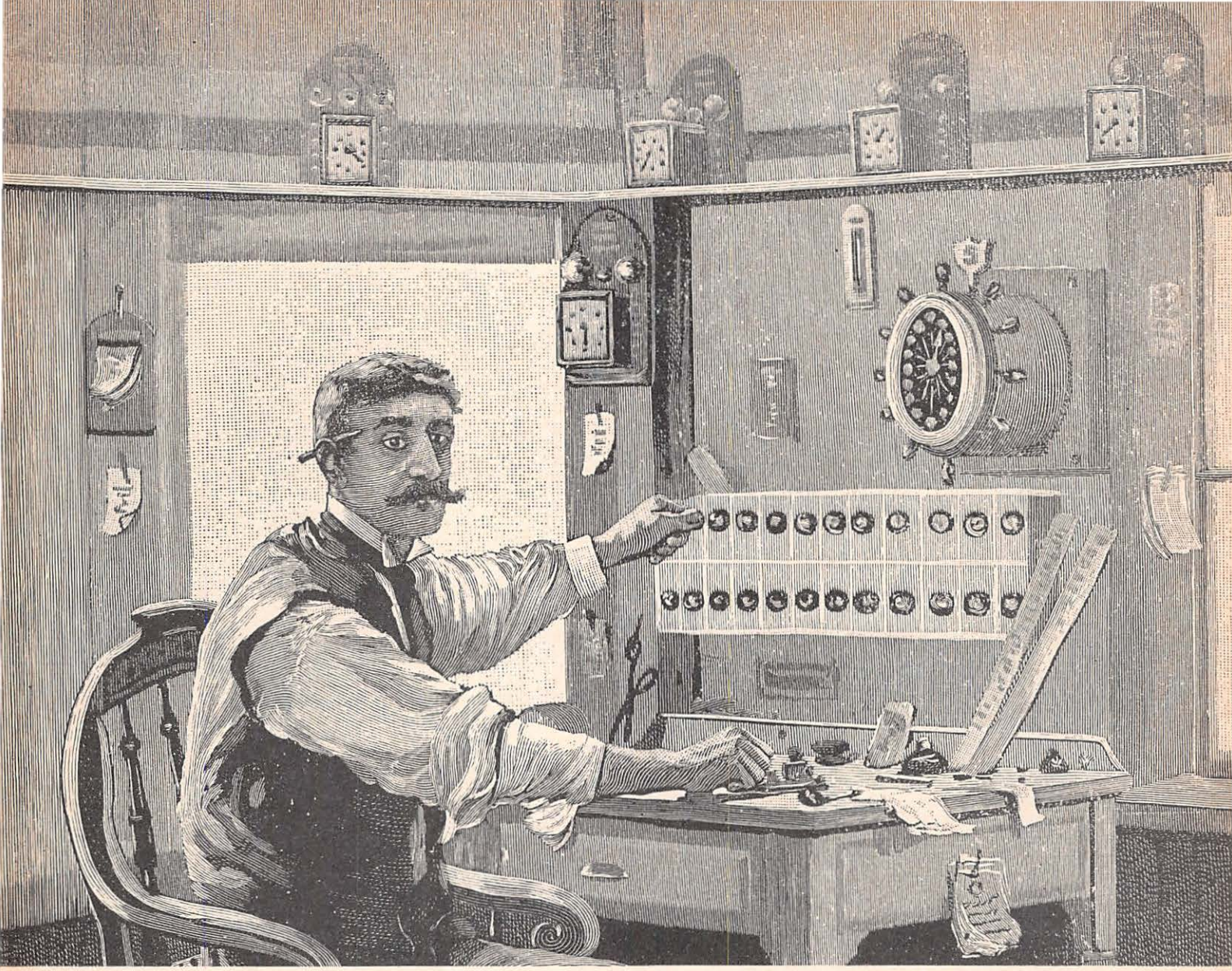


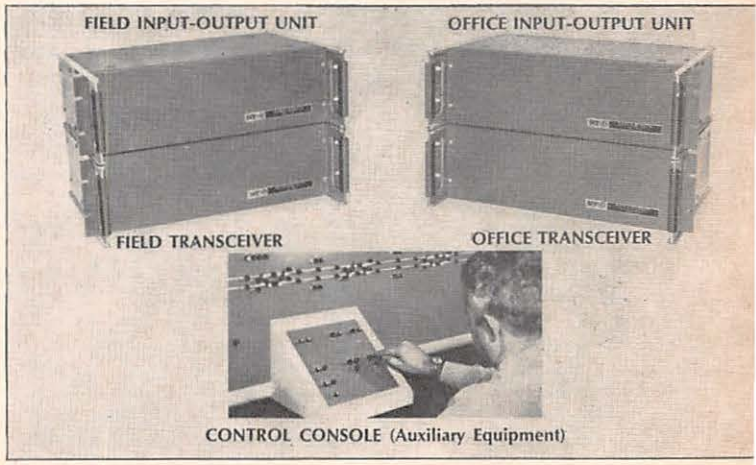
"Land sakes! What do they expect from one man? I told 'em I need a new Servoscan remote control system to handle all this traffic!"

SOUND familiar? The problem of efficient control of railroad operations hasn't really changed since 1888—it's just gotten worse. Today, railroad men face an ever-increasing array of new and more demanding competitive requirements—as well as the always-present factor of high labor costs.

To help railroads and rail transit operators achieve a greater degree of automation and economy, we've developed SERVOSCAN™, a new high speed solid state remote control system with self-checking reliability. SERVOSCAN is applicable to any multiple station installation that requires *control* of remote "ON-OFF" apparatus and *indication* (or monitoring) of remote "ON-OFF" contacts. Typical uses include centralized traffic control, multi-station interlockings, route check networks, classification yards, etc.

The integrated circuit design of SERVOSCAN makes it smaller, more reliable and less costly than equivalent non-vital relay equipment. A provision for manual stepping greatly simplifies field maintenance and checkout. Standard SERVOSCAN models are available to accommodate up to 64 remote field stations. A wide variety of control systems with different capacities can be easily assembled by merely stacking individual standard units.

Looking for a reliable and economical new way to improve your control system? Take a tip from our old friend, the 1888 dispatcher—take a look at SERVOSCAN. Just ask for Tech Data Publication 2006.



SERVOSCAN™ Remote Control System consists of four basic units: office transceiver, office input-output, field transceiver, and field input-output. Each unit measures only 5¼" x 11" x 17". Communication between office and field stations is by FSK carrier using return-to-zero coding. Auxiliary equipment is available from Servo on a custom-design basis, including control and display consoles, tape readers, solid state route check networks, manual local control panels, etc.

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Circle 6 on reader service card on page 38

News Briefs

● BROTHERHOOD OF RAILROAD SIGNALMEN had planned to strike the nation's railroads on Jan. 16, but they will have to wait at least another 60 days. President Lyndon B. Johnson appointed a presidential emergency board to investigate and report on the dispute between the BofRS and the railroads. The appointments were made Jan. 13 and consist of Laurence E. Seidel, chairman, Rolf Valtin and Jacob Seidenberg, members. All are reported to have had considerable experience in rail-labor affairs. Seidel and Valtin are from Washington and Seidenberg is from Falls Church, Va.

C. J. Chamberlain, BofRS president, said the notice to the railroads included the following:

1- Ten per cent wage increase for all employees effective July 1, 1968.

2- Eight per cent wage increase effective July 1, 1969.

3- Seven per cent wage increase effective July 1, 1970.

4- Recognized mechanics and other skilled workers to receive additional increases of 30¢ an hour effective July 1, 1968 and 15¢ more Jan. 1, 1969.

5- Fifteen cents an hour additional for skilled workers effective July 1, 1969 and 15¢ more starting Jan. 1, 1970.

6- Fifteen cents an hour additional for skilled signalmen effective July 1, 1970.

BofRS is requesting a cost of living adjustment each quarter starting Oct. 1, 1968, of one cent an hour for each three-tenths of a point change in the government's consumer price index.

Efforts of the National Mediation Board had failed to resolve this wage case. Chamberlain said that the membership had previously authorized a strike by a 97.4% vote of its members in the U.S. He said the average wage for skilled signal employees in the U.S. is $3.26 per hour.

● CHICAGO & NORTH WESTERN has placed its computer-communications network, known as Fastfax, into service. The system, built around four RCA Spectra 70 computers, is designed to handle message switching, freight car tracing and shipper inquiries on an automated basis. The system collects, monitors and transmits some 200,000 messages daily from freight yards in 11 midwestern states, as well as C&NW sales offices from coast-to-coast, over telephone circuits. Included in the system are three Spectra 70/45 computers and a Spectra 70/35 system along with 45 remote visual display units for information retrieval. These units consist of a CRT display tube with a typewriter keyboard. About 58,000 cars move daily over C&NW.

C&NW will spend $810,000 to extend its microwave system from Clinton to Marshalltown, Ia., and from Des Moines to Oelwein. Existing microwave on C&NW is in service between Chicago and Clinton, Ia., and Chicago and Milwaukee, Wis. Also, the road plans to install additional hotbox detectors between Oelwein, Ia., and Kansas City, Mo.

● COMMUNICATION & SIGNAL SECTION, AAR, has put out a call for papers to be delivered at the next annual meeting to be on Sept. 16-18, 1969 at the Queen Elizabeth hotel in Montreal, Que. Talks or paper presentations should be limited to about 30 minutes. Those desiring to give papers should send a brief digest of the subject, plus the name of the company and/or its representative who will give the talk to George McCann, Secretary, C&S Section, AAR, 59 E. Van Buren St., Chicago, Ill. 60605. Deadline for sending in requests to present papers is next month.

● DEPARTMENT OF TRANSPORTATION has awarded a contract to Westinghouse Electric Corp. for $143,000 to study linear electric motors along with power distribution and conditioning for use in 200+ mph ground transport vehicles. The linear electric motor portion of the study is centered on improved designs of the "reaction rail" or the equivalent of the rotor in rotating electric motors, which is located in the track and reacts with the motor coils located within the vehicle.

● GRADE CROSSING SAFETY will be the subject of a three day conference, Feb. 11-13, 1969 at the University of Illinois at Urbana-Champaign, Ill. This National Conference on Rail-Highway Crossing Safety follows a similar meeting in December 1967 held at Texas A&M University. Panel discussions and reports will be concerned with the latest developments in grade crossing safety research, selected grade crossing projects and programs, public-private agency relationships and problems and federal activity in grade crossing safety. Four workshops will cover administration of grade crossing programs, traffic operations at grade crossings. accident reports and investigations, enforcement at the crossing and public benefits from crossing programs.

● CANADIAN PACIFIC has placed orders for over $3.5 million with the Signal & Communications division of WABCO for a complete automatic freight classification yard system and mainline signaling for Alyth yard, Calgary, Alberta. The yard is designed to handle 3,000 cars daily. The control system at the yard will provide for automatic routing, car speed control, hump locomotive speed control, automatic weighing, automatic car identification and remote cab signal indicators. In addition, full inventory and car movement records for incoming train consists and full yard operating information will be made available to yard supervisors on electronic visual displays; and there will be no retarder operator or pushbutton console at the crest. Dual central process computers will be installed for automatic control and customer service functions at Calgary. The mainline signaling consists of CTC in the Calgary terminal area using a route-type control machine with solid state code equipment to consolidate controls of a number of interlockings.

● GREAT NORTHERN will install 48 road miles of CTC this year in Montana. This will bring the road's mileage of traffic control to nearly 1,425.

● INTERCONNECTION TARIFF and AT&T's other tariff on interstate long distance message telecommunications service were in effect on Jan. 1, 1969, although the FCC had received comments asking for suspension or rejection. FCC also provided for a series of informal engineering and technical conferences "broad in scope" at which interested persons and organizations will discuss "what further changes are ncessary, desirable and technically feasible." According to *Telecommunications Reports*, the Commission held that "the telephone system includes the telephone instrument which performs the 'network control signaling' functions for message toll service."

What it was concerned with in the Carterfone case, the FCC declared, was "what could be connected or attached to this telephone system." It went on, "our decision in 'Carterfone' does not hold that a customer may substitute his own equipment or facilities—whether it be telephone instruments, loops, poles or central office equipment—for that furnished by the telephone company in providing message toll telephone service as that service is defined in the tariff. Our decision dealt with interconnections and not replacements of any part of the telephone system."

But while it concluded that the tariff revisions filed by AT&T do not violate the Carterfone decision, the FCC held that "the question remains as to whether the telephone companies should make provision in their tariffs" allowing customer-furnished network control signaling units. Thus, it said, it will take further action after observing the impact of the new tariff revisions, and the informal proceedings which it set up.

● MASSACHUSETTS BAY TRANSPORTATION AUTHORITY has ordered four sets of black and white automatic car identification equipment and a cathode-ray tube display from the Signal & Communications division of WABCO. These four ACI sytems will be installed at Harvard and Ashmont on the Cambridge-Dorchester line and at Cambridge-Dorchester junction and Weymouth on the South Shore extension.

● NORTHERN PACIFIC has ordered a Class-Matic II freight terminal control and information system from General Railway Signal Co. to modernize its existing 47-track classification yard at Pasco, Wash. A general process control digital computer will automatically log and route inbound trains onto the various classification tracks. An existing analog computer will act as a standby unit.

(Please turn to page 33)

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. . . and he'll answer with one word: COMPAK-RR . . . the only packaged system providing selective ringing with 1500-ohm loop. And the only one of its kind to provide universal numbering. Our Man-on-the-Scene can deliver this system right off the shelf . . . assembled, fully wired, and ready for service.

The system has 100-line capacity. It is loop and/or E & M trunk-connected. It provides multiparty frequency-selective bridged ringing. Ten parties per line, maximum; 48-volt operation. Fully compatible with your present system. Backed by our total-support services.

This system is typical of many to be found in the large family of specialized communications equipment available—along with total-support services—from our Railroad Division. For complete information, write us, at 100 Carlson Road, Rochester, N.Y. 14603. Or call 716-482-2200.

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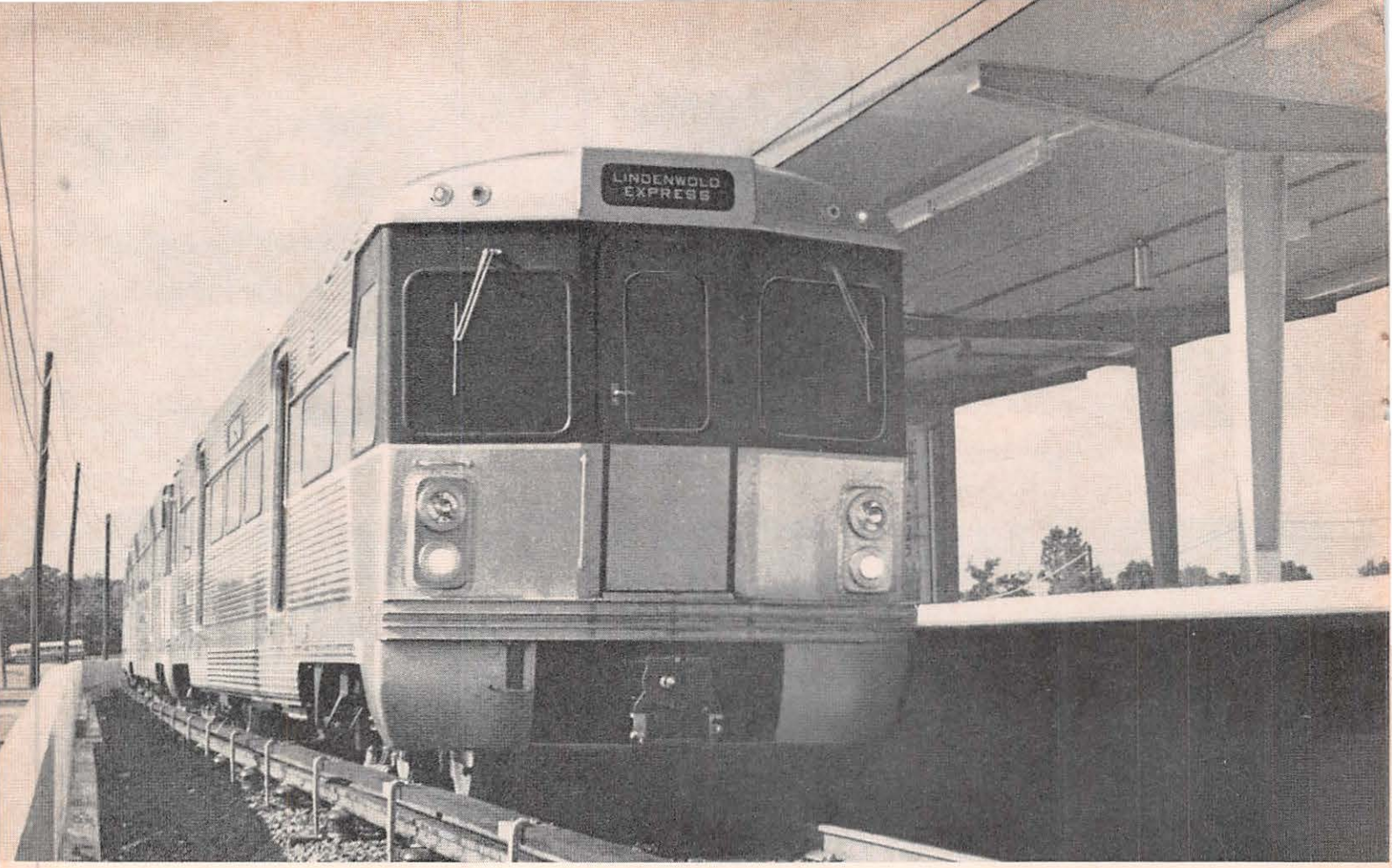


MOST AUTOMATED RAILROAD IN THE WORLD

That's Port Authority Transit Corporation's (PATCO) high-speed transit line from Lindenwold, N.J. to downtown Philadelphia, the first new commuter line on the east coast in more than 50 years. It was designed from roadbed up to convince skeptics that the commuter can be made to forsake his automobile.

Trains have a top cruising speed of 75 mph, a "first" for transit cars, with rush-hour headways as low as 3 minutes.

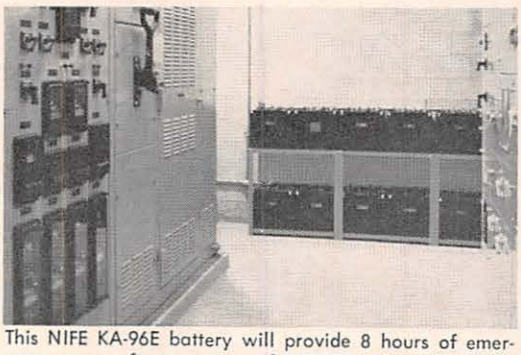
Advanced electronics gear aboard each train automatically maintain speed, actuate brakes, and trigger wayside signal equipment to control oncoming and following trains. All the operator does is open and close doors—and push a "go" button after each stop.

Because of the high speed . . . the tight headways . . . the automatic train operation, PATCO's signaling/communications system has to be reliable.

This means specifying reliable NIFE nickel cadmium storage batteries for the most critical emergency power supplies: back-up for the Center Tower where system operation is monitored 24 hours a day, and supervisory control at each of the line's 10 substations along the 14.5-mile right-of-way.

Cost conscious PATCO maintenance-of-way people gain an additional bonus from reliable NIFE batteries: watering will be required less than once a year.

Learn how NIFE nickel cadmium storage batteries can guarantee the performance of your critical systems — whether for telemetry such as the PATCO installations, or car retarders, crossing protection, signaling, radio communications, or for starting of engines in reefers. Ask to have a NIFE representative call.



This NIFE KA-96E battery will provide 8 hours of emergency power for operation of PATCO's Center Tower.

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Circle 8 on reader service card on page 38

RAILWAY CYBERNETICS:

Concentrators cut ACI costs

Wayside scanning costs can be reduced if the scanners are only required to read, identify and verify labels on passing rolling stock. This means that several scanners can be linked to a data concentrator which provides the hardware and software to provide outputs in machine language for computers or in alpha-numeric form for human reading.

How data concentrators can be applied in automatic car identification systems was discussed at last fall's Data Systems Division annual meeting. Herewith are abstracts of two papers presented. The first is by James Anderson, manager, railroad sales, transportation control systems, Sylvania Electric Products Inc. The second paper is by John N. Albertson, general superintendent communications-system, Southern Pacific Co.

KarTrak is an ACI data collection system that has been designed to permit the cost per scanning location to range from $357 to $673 per month.

The lowest wayside scanning cost is achieved when all functions, except for the capture, identification and verification of labels have been transferred from the scanning location to associate yard office equipment.

Initially every decrease in wayside scanning cost is accompanied by an increase in cost at the receiving location. However, once a certain number of scanners are required in a 25 to 50 mile radius, the complete hardware and software cost of a data concentrator is offset by the savings derived through the elimination of KarTrak options at each scanning location in the network. When the options eliminated equal the cost of the data concentrator, the break even point has been reached. Once the break even point has been obtained, each subsequent scanner added to the network yields a yearly cost reduction of some $1,800 to $3,300.

While primarily concerned with the Sylvania ACI/TCS-50 system, the same cost savings may be obtained, or even exceeded, by the use of a wide variety of equipment presently available, Anderson said.

In Figure 1 a good number of KarTrak options are installed at the wayside scanning location. The $623 configuration includes all options as shown, while the $551 configuration does not include the "broken line" options.

Now if all options except the message generator in the $623 configuration were eliminated, and a TCS-50 installed at the receiving location, a monthly wayside reduction of $236* could be realized per scanning location. At a level of 8 scanners the TCS-50 break even point will have been reached, and any additional scanner installed would result in an actual saving of some $2,800 per year.

For the $551 configuration, the number of systems required to reach the break even point is 12, and the approximate yearly saving for each additional system installed is $2,000.

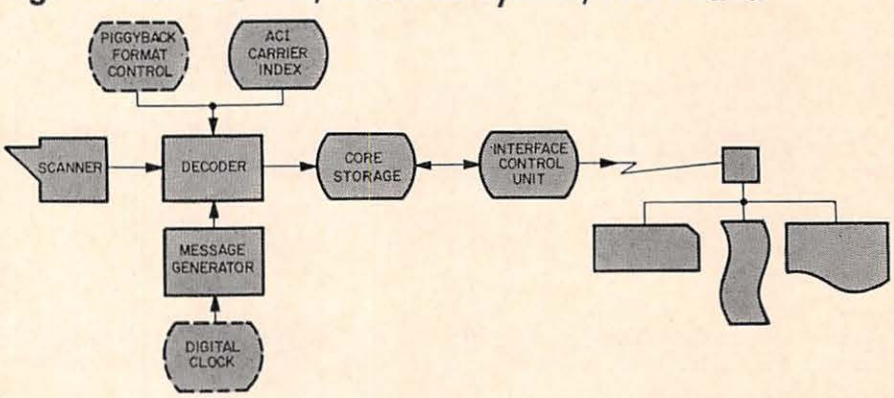
The break even analysis assumes a TCS-50 approximate cost with maintenance of $2,000 per month for the first four scanners serviced, and an additional $60 per month for each subsequent scanner added to the network (Lenkurt 26C data set and scanner/concentrator interface included).

No dollar savings have been assumed for intangible benefits derived from the direct machine production of edited consists or the automatic concentrator to computer transfer of assembled train messages.

With the elimination of KarTrak options at the wayside scanning locations and the substitution of a data concentrator for the selector calling unit, the $668 configuration requires a 7 scanner network to achieve the break even point (Figure 2). Thereafter, each additional scanner installed yields a yearly cost reduction of $3,300.

The monthly reduction obtained per scanning location has been lowered to reflect 26C data set charges.

Fig. 1—Point-to-Point, Buffered System, Not Polled

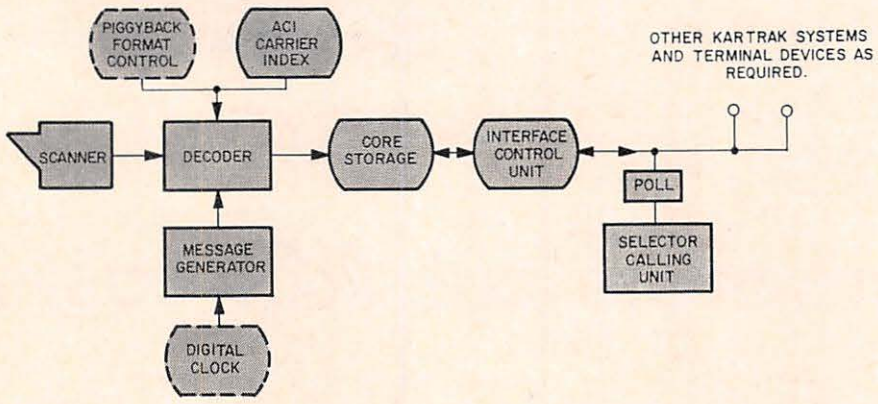


GENERAL CHARACTERISTICS

- RELATIVELY HIGH COST PER SCANNING LOCATION.
- RELATIVELY LOW EQUIPMENT COST AT YARD FACILITY.
- WAYSIDE EQUIPMENT INDEPENDENTLY CONTROLS DATA OUTPUT FROM BUFFER.
- DEDICATED LINES AND TERMINAL DEVICES FOR EACH SCANNING LOCATION.
- YARD TERMINAL EQUIPMENT IS NOT CAPABLE OF EDITING OR ASSEMBLY FUNCTIONS WHICH, IF REQUIRED, MUST BE PERFORMED BY CLERICAL PERSONNEL AND/OR AUXILIARY EQUIPMENT.

WAYSIDE SCANNING COST.....$551/OR $623
(With Maintenance)

Fig. 2—Multi-Point, Buffered System, Selector Polled

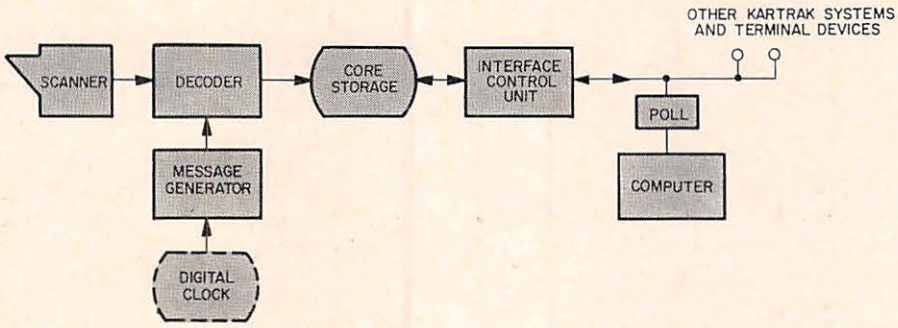


GENERAL CHARACTERISTICS

- EQUIPMENT COST PER SCANNING LOCATION IS SLIGHTLY INCREASED WITH THE ADDITION OF ERROR DETECTION AND RETRANSMISSION CAPABILITY.
- DATA OUTPUT FROM WAYSIDE EQUIPMENT CONTROLLED FROM YARD EQUIPMENT.
- SHARED TRANSMISSION FACILITY AND COMMON TERMINAL.
- YARD TERMINAL EQUIPMENT IS NOT CAPABLE OF EDITING OR ASSEMBLY FUNCTIONS WHICH, IF REQUIRED, MUST BE PERFORMED BY CLERICAL PERSONNEL AND/OR AUXILIARY EQUIPMENT.

WAYSIDE SCANNING COST.....$596/OR $668
(With Maintenance)

Fig. 3—Multi-Point, Buffered System, Computer-Polled



GENERAL CHARACTERISTICS

- REDUCTION OF WAYSIDE SCANNING COSTS PER LOCATION BY TRANSFERRING "REDUNDANT" FUNCTIONS TO A YARD/CENTRAL COMPUTER (CARRIER INDEX, PIGGYBACK FORMAT).
- INCREASED COMPUTER HARDWARE & SOFTWARE COSTS ARE OFFSET AS THE NUMBER OF SCANNERS MONITORED INCREASES.
- COMPUTER IS CAPABLE OF PERFORMING EDITING & ASSEMBLY FUNCTIONS.

WAYSIDE SCANNING COST.....$ 537/OR $ 570
(With Maintenance)

The $596 configuration requires 10 scanners for break even, with subsequent systems installed yielding a yearly reduction of $2,500.

In Figure 3 wayside scanning costs have been reduced as a result of transferring functions and controls from wayside equipment to a computer. The carrier index, piggyback format control, and in some cases the digital clock have been eliminated.

Systems consideration and computer programming cost aside, the $570 configuration requires a network of eleven scanners before the break even point is achieved, and a yearly cost reduction of $2,200 for additional scanners installed obtained.

The $537 configuration requires a 14 scanner network with additional systems installed yielding a yearly cost reduction of $1,800 each.

The TCS-50 can be a supplement to, and not a replacement for, the computer. Obviously, a comprehensive total systems study is required before any approach can be finalized.

In Figure 4 wayside scanning cost is reduced as a result of transferring all but the label reading functions transferred to an on-line, real time system. It is assumed that ACI is assigned the highest interrupted priority in the system.

The TCS-50 approach (Figure 5) assumes that ACI data can be most economically collected, edited, and assembled for local print out and integration into the total MIS system by a dedicated on-line real time data concentrator.

Data concentrators can be a very promising means by which total ACI costs may be lowered. Many complex and costly systems' considerations such as back up, line charges, and programming development costs have been purposely excluded as they are best developed by in-house railroad groups.

ACI CONCENTRATORS

SP's Albertson reported on the development of performance specifications and operating requirements for ACI concentrators and communication interface with central computers. The manner in which concentrators will perform are dependent largely upon the task at hand. Even under these circumstances certain parameters, both functionally and electrically, must be observed. Moreover, it should be understood that any scanner properly equipped is capable of operating on a "stand-alone" basis. Some of the concentrators available for use in connection with ACI scanners are as follows:

W.E. 83B

Code	Interface
5 level Baudot	60 mil. loop
5 level Baudot	EIA

Functions: Polling, Answer Back, Transmission, Detection Abnormal Alarm

(Sylvania 1C-20-A interface control unit equivalent to above except less equipment, has capability of sensing abnormal operation, stopping transmission and retransmission three times. Baudot and ASCII codes.)

W.E. 8A1 (or Sylvania equivalent)

Code	Interface
ASCII	60 mil. loop
ASCII	EIA

Functions: Same as above, even or add parity.

(Sylvania equivalent to above except less equipment, has capability of sensing abnormal operations, stopping transmission and retransmission three times. Can operate in both codes.)

IBM 1050	
Code	Interface
BCD 1248	EIA

Functions: Vertical and longitudinal redundancy check as well as block and message retransmission capabilities.

(Sylvania 1C-10-1 interface control unit is equivalent to 1050 functions with same capability from electrical standpoint.)

A significant point to keep in mind is that in all above-mentioned control interfaces, it is required that the ACI scanner be equipped with a buffer, either Sylvania CB500/CB1000 label core buffer or equivalent, and in addition a message generator (Sylvania G-64). The buffer will store the information until called for. The message generator will provide the message sequence number, train direction, scanner number or location, end of address, format number, start of message, end of message and other fixed information.

The message generator will also receive information from such sources as train direction, calendar clock, message sequence number, etc.

The question of communications interface and transmission facility becomes largely a matter of choice. Since the system is buffered at the scanners, there is no great need for transmission at high speeds, except when necessary, it follows then that transmissions at 45, 75, 110 or 150 bits per second will suffice. If the operation is over a private network there are available many types of modems for interfacing the scanner unit and the control or master location.

The requirement for low speed communications interface (data sets) generally as follows:

Baud rate:	45, 75, 110, 150
Line Impedance:	600 ohms
Power:	110V AC, 48-24DC
Modulation:	FM
DC Interface:	60 mil loop EIA

The Communication & Signal Section of the AAR has available a comprehensive library on a large number of various types of data modem sets and reference should be made to this section for anyone wishing specifications or specific information on a particular type data set.

This, in brief, are the various arrangements of connecting ACI scanners to work in conjunction with 83A, 83B and 8A1 and 1050 type environment. All scanners involved with this type operation may be referred to as the "stand-alone" or individual type; i.e., they can operate point to point independently into a printer on a DC basis or through a data set.

There is available, however, another somewhat more controversial method of operation of scanners. This applies when the scanners are under the control of a CPU (central processing unit), be it an IBM, General Electric, Sylvania or other. There are certain fundamental differences in this type of operation that implies constraints not heretofore mentioned.

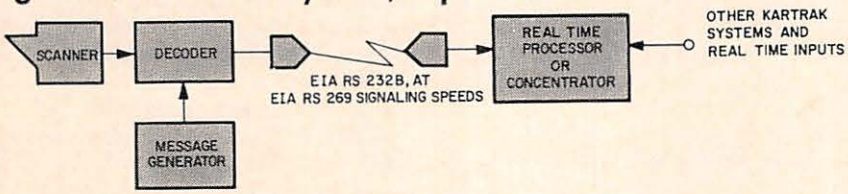
For one thing the communication link has to be substantially upgraded. Where slow speed channels were satisfactory in the previous case, it is now necessary to operate at speeds from 600-1200-2400 baud. The requirement to handle large blocks of information makes use of an entire voice channel where before a single data channel was used.

Also, the possibility of error is increased since at higher speeds the bit duration is considerably shorter than at the lower speeds. Noise bursts that previously had little or no effect at the slower speeds becomes most significant at the high bit rate. Notwithstanding, higher bit rate operation is available and in use throughout the country in many applications and higher speeds will no doubt be used in everyday operation when required.

Assuming the communication link adequate and ready for operation, there are certain profound advantages to be gained from operating ACI scanners under the control of a central processor. For one thing the scanners will be reduced in cost by approximately 40%. This savings can be applied toward the cost of a CPU. Cost figures indicate the crossover point to be about 10 to 12 scanners. That is, if an application can be developed utilizing 10 ACI scanners, the savings accrued would be enough to pay for the CPU and at the same time realize substantial benefits from the capability offered by the central processor.

While most any suitable CPU could be used, Albertson used as an example the IBM 1800 Process Control and Data Acquisition computer as a data concentrator for ACI scanners. Its ability to act as a large, intelligent buffer offers

Fig. 4—Unbuffered System, Input on Demand

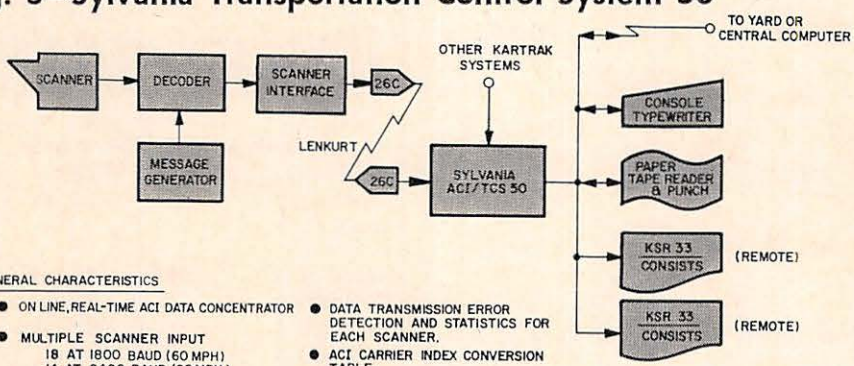


GENERAL CHARACTERISTICS

- SUBSTANIAL REDUCTION IN WAYSIDE SCANNING COSTS PER LOCATION BY THE TRANSFER OF "REDUNDANT" SCANNER FUNCTIONS TO DATA CONCENTRATOR (CORE BUFFER, DICTIONARY, CLOCK, PIGGYBACK FORMAT, INTERFACE).
- SIMPLEX, HIGH SPEED TRANSMISSION OVER STANDARD VOICE GRADE LINE.
- DEDICATED/SHARED PROCESSOR FOR THE RECORDING, ASSEMBLY, VERIFICATION, EDITING, OUTPUTTING, AND STORING AND FORWARDING OF TRAIN MESSAGES.

WAYSIDE SCANNING COST $357
(With Maintenance)

Fig. 5—Sylvania Transportation Control System 50



GENERAL CHARACTERISTICS

- ON LINE, REAL-TIME ACI DATA CONCENTRATOR
- MULTIPLE SCANNER INPUT
  18 AT 1800 BAUD (60 MPH)
  14 AT 2400 BAUD (80 MPH)
- SOFTWARE PACKAGE:
  REAL TIME TRAIN ASSEMBLER
  TRAIN EDITING ROUTINES
  PRINT CONSIST ROUTINES
  CONCENTRATOR-COMPUTEP POLLING ROUTINES
- AUTOMATIC STORAGE PROTECTION AND RESTART ON POWER FAILURE.
- DATA TRANSMISSION ERROR DETECTION AND STATISTICS FOR EACH SCANNER.
- ACI CARRIER INDEX CONVERSION TABLE.
- DIGITAL CLOCK
- MAN-MACHINE INTERROGATION.
- 2500-3000 CAR OR 25-30 TRAIN CAPACITY
- MODULAR EXPANSION FOR FILE MAINTENANCE AND REPORTS ON SCHEDULED OR DEMAND BASIS, AND ADDITIONAL OUTPUT DEVICES.

TENTATIVE "STAND ALONE" CONFIGURATIONS

A. At yard entrances and exits and main line track wherein train reversals and multiple entries and exits to blocks do not occur:

BASIC SYSTEM	Monthly Lease & Maintenance	Purchase°
Includes—		
Scanner with mounting mask	$337.25	$ 9,400.
Decoder		
Parity check circuitry		
Bad label designator		
Unlabeled car detector		
Interface		
Keying contacts for 60 ma loop for TTY		
EIA RS 232B at EIA RS 269 signaling speed		
5 or 8 level output code selection		
Piggyback capability without format control		
OPTIONS		
Message Generator	19.75	550.
Core Storage	122.00	3,400.
Carrier Index	59.00	1,650.
Piggyback Format Control	39.45	1,100.
Calendar Clock	33.00	920.
Stacked Container Capability	50.25	1,400.
COMMUNICATIONS INTERFACE:		
°° a. Buffered System, no polling or retransmission, 60 ma. EIA RS. 232B	12.55	350.
°° b. Buffered System Computer polled, 60 mil EIA and answer back with full retransmission capability	$ 58.00	$ 1,600.
TOTALS:		
Without Polling and Retransmission	$673.25	$18,770.
With Polling and Retransmission	$718.70	$20,020.

°° This would be either or situation
° Maintenance at 1% per month

NOTES:
1. Data Set charges not included. These figures will vary between $1200-$1600 per location.
2. If magnetic tape replaces core storage, subtract $25 monthly and $700 purchase from all configurations.
3. Housing for Decoder—add $43 monthly or $1200 purchase price.

	Monthly Lease & Maintenance		Purchase°	
	Without Polling & Retransmission	With	Without Polling & Retransmission	With
B. At locations where multiple entry and exit to a block takes place, add estimate ($35 monthly and $976 purchase to configuration A. cost.)	$708.25	$753.70	$19,746.	$20,996.
C. At locations where train reversals take place, add estimate ($45 monthly and $1233 purchase to configuration A. cost.)	$718.25	$763.70	$20,003.	$21,253.
D. At locations with multiple block entries and exits and main reversals, add ($80 monthly and $2209 purchase to configuration A. cost.)	$753.25	$798.70	$20,979.	$22,229.

° Maintenance at 1% per month

NOTES:
1. Data Set not included. These figures will vary between $1200-$1600 per location.
2. If magnetic tape replaces core storage, subtract $25 monthly and $700 purchase from all configurations.
3. Housing for Decoder—add $43 monthly or $1200 purchase price.

many advantages when associated with the data concentrator concept of the IBM 1800 type is considered. This is a process control and data acquisition computer and besides its ability to act as a large, intelligent buffer performing editing and preprocessing of scanner data prior to transmission to a central computer system, it can also perform the following functions:

Control capability. With a small amount of additional hardware for interfacing with yard sensory and control equipment, the computer can be used to control a hump yard. Retarder control, switch setting, movement monitoring, and yard inventory are possible applications of the expanded concentrator-yard computer system.

Data processing capability. The 1800 can use the inventory, car scanner and consisting records to provide most of the reports needed by local yard management. Because the data transmission connection established between the 1800 and the central computer system (and perhaps other 1800's around the railroad) for data concentrator purposes, the same communication lines can be used to transmit advanced consists to the 1800, corrected or exception consist reports (including new consist car records) from the 1800's data processing capability, the central computer systems load arising from scanner data input can be greatly reduced.

Data Concentrator: Scanner–IBM 1800 connections. Much of the additional equipment available with the scanner is not needed when the IBM 1800 is used as a buffer for a number of scanners.

The unbuffered scanner system (envisaged for connection with the data concentrator) has two options available for interface with data transmission equipment. The first is standard EIA RS-232-B interface at speeds up to 2400 baud, the second is a keying contact for a 60 ma loop. The IBM 1800 computer with a deserializer attachment receives data from either of these two interfaces. (Transmission rates from scanners must be specified at time of purchase and are directly related to the maximum speed of the trains expected to pass scanner locations.) Assuming 6 ft minimum separation between labels and no label stacking, the relationships between different baud rates and train speeds are shown below:

Baud Rate	Maximum Speed (mph)
2400	72
2000	64
1800	58
1200	42
600	23
300	12
150	6
75	3

TENTATIVE UNBUFFERED CONFIGURATION

	Monthly Lease & Maintenance	Purchase
BASIC SYSTEM	$337.25	$ 9,400.
Message Generator	19.75	550.
OPTIONAL		
Entrance & Exit Designator	35.00	975.
Train Reversal Designators	45.00	1,200.
Housing (single unit)	43.00	1,233.
TOTALS:	$480.00	$13,358.

If the scanner is located less than five miles from the IBM 1800, the contact closure interface could be used, and no data sets would be required. Transmission would be made via a pair of wires (e.g., telephone wire). But in this case, the transmission rate associated with the contact closure would limit train speed to six mph or less. Otherwise, two data sets will be needed for each scanner connected to the IBM 1800. The deserializer attachment's function is to receive information which is serial by bit and character and convert it to parallel by bit, serial by character (two devices in the IBM 1800 together perform this function).

The scanner transmits data in a five bit Baudot code which is accepted by the IBM 1800. The code has no self checking facility, which although not required by the computer, would be useful to facilitate character checking during transmission from the scanner to the IBM 1800 (or the central computer system).

Number of Scanners attached to one IBM 1800. There are three possible limiting factors regarding the number of scanners attached to an IBM 1800. These are as follows:

(1) *Hardware.* Since many operations may be vying for attention from the IBM 1800 at the same time, it is necessary to be able to respond to them in a logical and planned fashion, keeping strict regard of those operations which must be serviced on a very high priority.

The IBM 1800 has 12 levels of priority interrupt available for allocation to different types of inputs which may be coming from different sources in a random fashion (an additional 12 levels is available). The levels function in the following way. Each level has a priority with respect to the other levels; an interrupt on level two will take precedence over an interrupt on level five, and level five operations will be temporarily suspended until the higher level interrupt has been serviced. If the level two operations are also suspended by an interrupt at level one, then the level five operations will not be resumed until the level one interrupt has been serviced and the level two operations resumed and completed. A number of different interrupt signals can be connected to one interrupt level.

It is envisaged that ACI scanners would be allocated a very high priority on this priority interrupt scheme. If the computer were acting solely as a concentrator, we probably would be able to simplify the priority scheme to a large extent (apart from the need to insure the scanners would have priority in the 1800 over data editing and transmission to a central computer). However, the priority scheme is critically important to the computer acting as both concentrator and yard system. ACI scanners would still have high priority, but the next level would come yard control sensors (the scale, wheel counters, etc.), then data communications with other computers and inquiries from inquiry stations located around the yard (e.g., in the group retarder tower) and so on.

The real time interrupts from scanners and yard sensors which are handled by the priority interrupt scheme are connected to the computer through a series of devices (PISW's—Process Interrupt Status Words) in the 1800. (Up to 16 of these PISW devices used can be allocated to one priority level and to one type of input device, or they all can be allocated to a number of different devices acting on different priority levels.) There are 24 PISW's standardly available on the IBM 1800 and this number could be raised to 42. This means that an 1800 acting solely as a data concentrator could have 24 (or 42, through a special feature) scanners physically attached to it. An 1800 acting jointly as a data concentrator and a yard computer, would share this number between scanners and inputs coming from yard sensors. Communica-

TYPICAL COST TO FURNISH ELECTRICAL POWER FOR ACI SCANNER LOCATIONS

	Material	Labor	Total
A. * Railroad to furnish power service only	$140.	$125.	$265.
* Assumes local power available, no long line construction.			
B. Railroad to furnish "A" above and in addition furnish equipment and air conditioners and wire building (See attached sheet for emergency power if required.)	$700.	$300.	$1,000.
C. Railroad to furnish building			$1.000.
Railroad to furnish foundation for building			200.
Railroad to furnish foundation (1) for scanner mast			75.
D. Railroad to furnish signaling rquirement in connection with ACI scanner operation:			
E.T.C. (Receiver & Transmitter)	$375.		
Track wiring	30.		
E.T.C. Battery & Housing	205.		
Cable & Bootleg at Scanner	20.		
Store & Purchase Expense	30.		
Labor to install		$150.	
Contingencies	70.	15.	
Total:	$730.	$165.	$895.

Estimate to Provide Emergency Power, if required:

	Labor	Material	Total
Standby Generator in Weatherproof Housing (7.5 KW), incl. slab		$1,475.	
Automatic Transfer Panel		450.	
Propane Gas Tank and Piping		385.	
Misc. Material		55.	
Labor to install	$175.		
Total:	$175.	$2,365.	$2,540.

tions equipment to other computers, data processing input/output devices attached to the computer, etc., require very few PISW's but must still be under the priority interrupt scheme.

(2) *Computer load.* This second possible restriction breaks down into two parts. First, the number of ACI labels which could be read into the 1800 computer, edited and transmitted to another computer, is over 2 million a day. Clearly, this is not a limiting restriction.

Studies have been made of scanner loads on 1800's acting initially as data concentrators for typical clusters of scanners around a yard location, which indicate the computer time used for the scanner data concentration task at less than 5% of the time available on the 1800.

It appears that the maximum number of scanners which could be transmitting simultaneously to an 1800 at the peak transmission rate of 2400 baud (i.e., all 72 mph trains) is between ten and fourteen. This assumes labels are moving in front of all these scanners at the same time. (This assumes an 1800 with a cycle time of 2 microseconds.) (The slower four microsecond 1800 maximum, under these conditions, would be five to seven scanners.) If the scanners were transmitting simultaneously at 1200 baud (42 mph) the two microsecond 1800 could handle 20 to 28 scanners, and so on.

(3) *Practical considerations.* It appears then that the only limiting factors come from practical considerations, regarding the number of scanners which will be connected with one 1800, such as a railroad's planned use and location of scanners, the extent of the yard control function planned for the computer, the amount of yard data processing planned for the computer. It does not appear that the 1800, acting purely as a data concentrator, will have any difficulty servicing the scanners allocated to it by a railroad. Further studies seem to indicate the 1800 would have sufficient processing time left after serving what would appear to be the worst case for a typical yard scanner cluster of 10 scanners transmitting simultaneously at 600 baud (23 mph), to service a worst case of ten interrupts coming simultaneously from ten cars in the fan of a hump yard and to maintain the desired retarder control, switch setting, and car monitoring functions.

Each disk storage available with the IBM 1800 computer has a capacity of 500,000 words (16 bits for each word), or 2 million characters, giving a capacity for buffering 100,000 labels. Up to 6 disk storage devices can be attached (3 by RPQ).

The 1800 can be connected with a central IBM S/360 system, or another 1800, with devices which will permit data transmission rates between these computers of up to 2400 baud.

The reduction in the amount of equipment needed by a scanner if it is to be connected with the 1800 acting as a data concentrator, instead of with a remote central computer system, is significant. Depending on the number of scanners involved, this may account for a large proportion of the cost of the 1800 (in some cases, it may represent the total cost of the 1800 system).

A basic 1800 system configured as a data concentrator (it would be enlarged for significant yard applications) with 8K storage and a four microsecond cycle time, and connections for nine scanners, would cost approximately $108,000. This system would have a significant amount of processing time left for various yard and accounting applications after servicing these scanners and editing and transmitting the scanner data. The system could be easily expanded to encompass hump yard control, yard inventory and accounting applications.

The 1800 as Data Concentrator and Yard Computer System. Because of the capabilities of the 1800 system, it is advisable to consider that it should also be used as heavily as possible to service the yard, around which the scanners associated with the computer are clustered.

The IBM 1800 system has the capability of expanding heavily into these areas. This involves the complex sharing of the computer between a number of different applications.

In many computer installations, data processing functions are performed sequentially, a new function not beginning until the current one is completed. However, in the environment which the 1800 serves, an application's processing may be interrupted and suspended to allow immediate response to a high priority input. Further, the average application performed by the 1800 requires, at any given time, only a fraction of the total processing capability of the system.

To increase the throughput of the 1800 and to insure the integrity of the priority interrupt scheme (and, hence the timeliness of responses to these interrupts), a Multiprogramming Executive System (MPX) is available for the 1800. This is a FORTRAN oriented, disk based operating system which enables programs, core storage space and input/output facilities to be allocated

IBM EQUIPMENT

	Purchase Price	Monthly Rental
1. BASIC COMPUTER, including:		
1801-1B Proc. Cont., 8K, 4us	$55,700.	
7926 Paper Tape Adapter	1,600.	
1054-2 Paper Tape Reader	1,550.	
1816-1 Printer Keyboard	2,930.	
2310-A1 Disk Storage	13,500.	
Total:	$75,280.**	$1,985.
2. AUTOMATIC RESTART, including:		
C08219 Auto Restart	1,400.	
C08367 Disk Fast Restart	1,900.	
Total:	$ 3,300.	85. (Option)
3. COMMUNICATION WITH CENTRAL COMPUTER, including:		
C08413 Comm. Adapter	7,200.	
C08449 Comm. Application	400.	
3612 Electronic Contact Operate	800.	
3295 Digital Output Adapter	600.	
3296 Digital Output Control	600.	
5716 Process Interrupt Voltage	800.	
5710 Process Interrupt Adapter	900.	
C08281 Filter Modify	80.	
Total:	$11,380.	323.
4. SCANNER INTERFACE, including:		
a) C08643 (one per scanner)	$11,400.	300.
b) C08642 (one per each 3 scanners)*	$ 6,840.	180.
TOTAL SYSTEM PRICE	$108,200.	$2,873.

** For same equipment, but 2 microsecond cycle time—use $88,000 purchase $2,324 monthly rental.

* 1826's may be needed for housing

RENTAL COST COMPARISON 1800 VERSUS "STAND-ALONE" SCANNERS

	Stand-Alone Scanners	With 1800 Scanners
Basic system	$337.00	$337.00
Message Generator	19.75	19.75
Core Storage	122.00	
Carrier Index	59.00	
Piggyback Format Control	39.45	
Calendar Clock	33.00	
Communication Interface	12.55	
Total:	$662.75	$356.75

Stand Alone: $622.75
With 1800: — 356.75

Basic system is $266.00 per month less than "stand-alone" system.

Savings on 10 scanners	$2,660 per month
Cost to rent 1800 computer "stand-alone"	$2,550 per month
Cost to rent 1800 with 360* capability	$2,873 per month

* 1800 computer with 1800/360 configuration at $2,873 per month is somewhat higher than "stand-alone" 1800. However, additional capability would provide for output transmission and selection of 1050 equipment. Additional small increase in monthly rental would permit upwards of 6 simultaneous circuit transmissions to 1050 with various numbers of 1050's assigned to particular lines dependent upon traffic volume requirements.

and concurrently shared among several applications. This system insures that as much of the total system as possible is kept busy performing productive work as much of the time as possible. MPX is intended for process control and data acquisition applications which have high system usage requirements, such as an 1800 acting as a data concentrator for ACI data acquisition, and as a yard computer for hump yard control and inventory and consisting applications.

MPX provides the overall capability of multiprogramming with a fixed number of jobs. The system permits from one to 24 separately scheduled programs to reside in predefined sections of core storage. The use of disk storage for holding programs not in current use is carefully planned.

Two types of programs are used in multiprogramming systems such as MPX; foreground and background. Background jobs here are normally initiated from a batch processing monitor from the stack of jobs whose execution is not critically time dependent. Examples of these in a yard environment would be daily performance summaries, car handling reports, and some aspects of consisting. Foreground jobs do not execute from a stack; they are initiated by the occurrence of random or periodic real-time events such as a scanner transmitting labels, a car rollability input, a wheel counter, etc. Background and foreground programs are initiated and terminated in a largely independent fashion. MPX is capable of concurrently operating one background and up to 24 foreground programs. Priority for processing is based on the multi-level priority interrupt scheme mentioned earlier, which is strictly controlled by the executive director of MPX with foreground programs having priority over background programs. When an interrupt occurs, the director takes control, processes the interrupt and gives control to the highest priority interrupt's program.

The 1800 acting as a data concentrator and a yard computer will have spare capacity to perform background jobs, and so the time sharing techniques of MPX can be used whenever idle or free processing capability is available. Time sharing under MPX also insures the sharing of the full range of the computer's resources, as not only time, but also input/output facilities, secondary storage, etc., are shared.

The other functions which the expanded 1800, acting as a data concentrator, can perform are as follows:

(A) Retarder control, switch setting, and car monitoring can be adequately performed by the 1800. Inputs from the yard sensors describing weight and velocity, input from wheel counters, switch setting monitoring, etc., so as to insure all input needed for retarder control, and switch control, as well as performing the constant monitoring of a car's progress from the hump to the classification tracks can be brought into the 1800. The 1800 can perform the computations needed to execute these functions of retarder control and switch control.

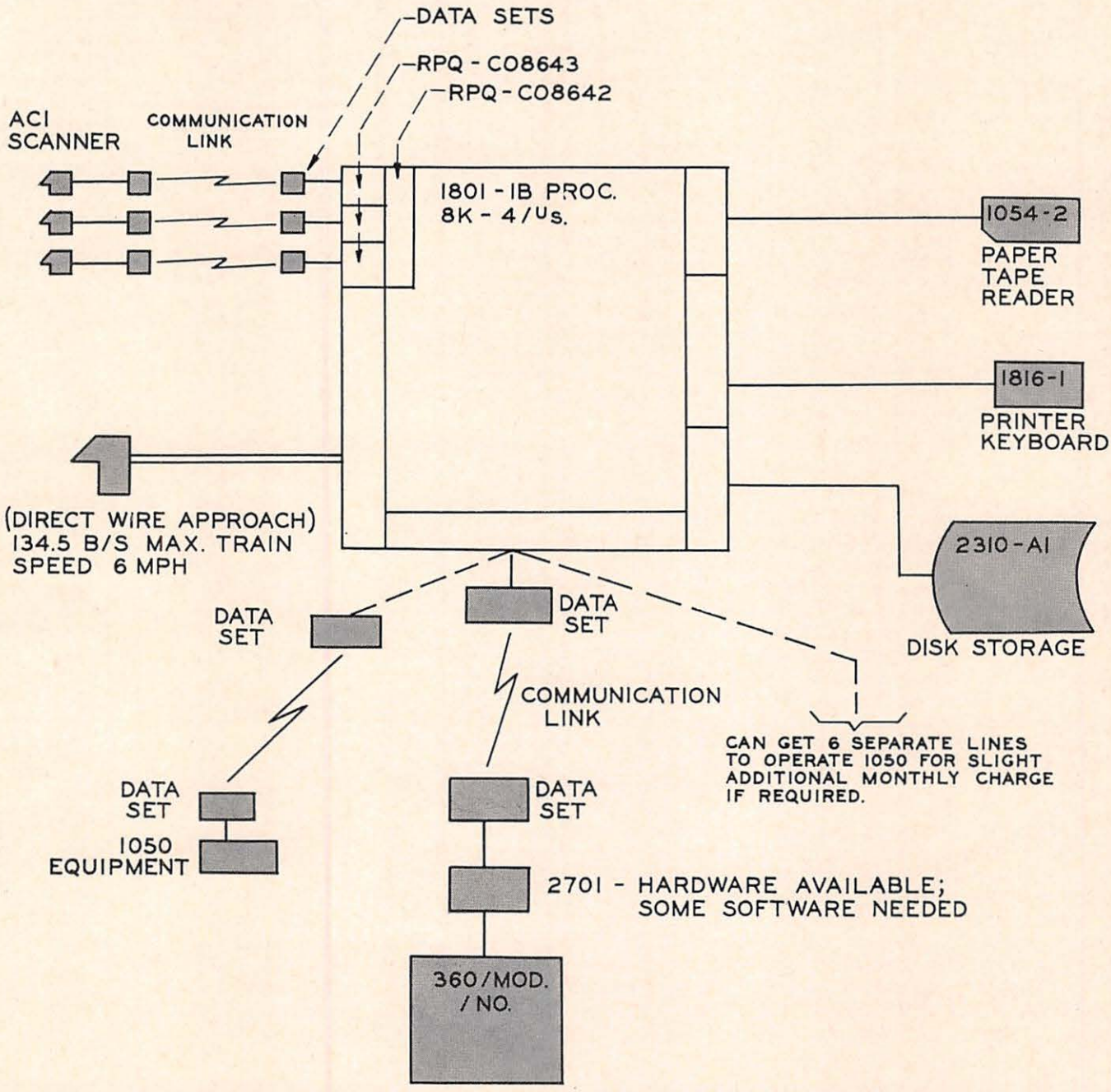
(B) Inbound advance consist receipt, outbound advance consist compilation and transmission, consist checking and correction arising from train scanner passing records, and consist car record generation can be performed by the 1800 communicating with a central computer system and other 1800 data acquisition/yard computer systems.

(C) Input from manual sources, track circuitry, wheel counters, as well as ACI scanner passing records, into the 1800, will allow the 1800 to perform a yard inventory service; maintaining an inventory of car locations and cars

RENTAL VS. PURCHASE OF 1800 WITH AND WITHOUT 'STAND ALONE' SCANNERS

ITEM Number	(A) 1800, 4 microsecond cycle time 1800/360*		(B) "Stand Alone" 1800, 4 microsecond cycle time		(A) 1800, 2 microsecond cycle time 1800/360*		(B) "Stand Alone" 1800, 2 microsecond cycle time	
	Purchase Price	Monthly Rental	Purchase Price	Monthly Rental	Purchase Price	Monthly Rental	Purchase Price	Monthly Rental
1.	$75,280.	$1,985.	$75,280.	$1,985.	$88,000.	$2,324.	$88,000.	$2,324.
2.	3,300.	85.	3,300.	85.	3,300.	85.	3,300.	85.
3.	11,380.	323.	—	—	11,380.	323.	—	—
4.(a)	11,400.	300.	11,400.	300.	11,400.	300.	11,400.	300.
4.(b)	6,840.	180.	6,840.	180.	6,840.	180.	6,840.	180.
TOTALS:	$108,200.	$2,873.	$96,820.	$2,550.	$120,920.	$3,212.	$109,540.	$2,889.

* Has hardware for 1800/360 communications.



Functional diagram showing inter-relationship between ACI scanners, 1800 concentrator and 360 central computer.

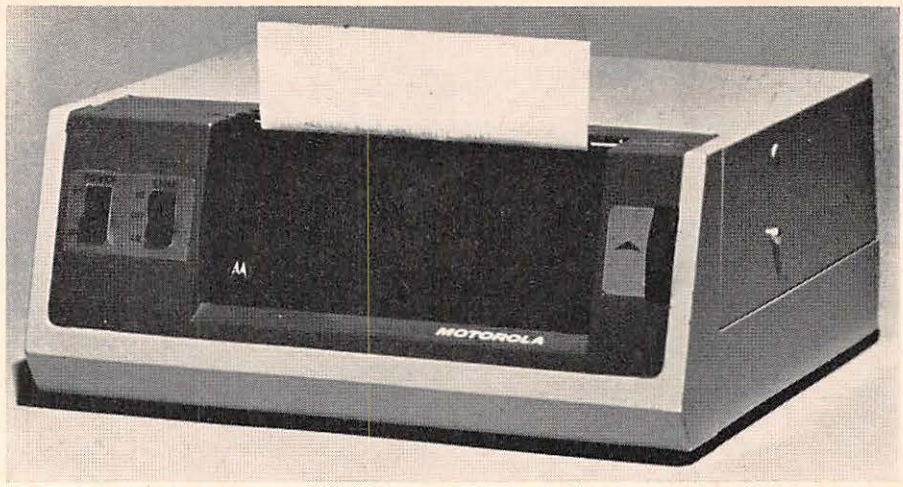
standing on tracks for use by local yard management, and car tracing, and local accounting applications.

(D) A series of graphic display terminals and typewriter-like terminals connected to the 1800, and located in various places around the yard requiring access to the car inventory and consisting data, and from whom is required data describing car movements, is possible. These terminals and their access to these data would greatly benefit local operations.

In summary, the data concentrator concept to remotely control the data gathered by ACI scanners and its transmission to other computer systems is shown to be feasible. There appears to be no practical limitations to small data acquisition and control computer systems serving in this capacity, and they are more than justified by reduced scanner expenses, reduced data transmission loads to a central computer system, and reduced storage requirements and processing capability which would be needed at the central computer facility to handle all data gathered from ACI scanners.

Furthermore, it is important to note that these process control computer systems, because of the natural clustering of many scanners around yard locations, and the spare processing capability left unused from the workload arising from scanner applications, have significant promise for immediate use as a yard computer system, in addition to the data concentrator function. Thus, the data made available by ACI scanners can be used to great advantage at an early date in yard locations.

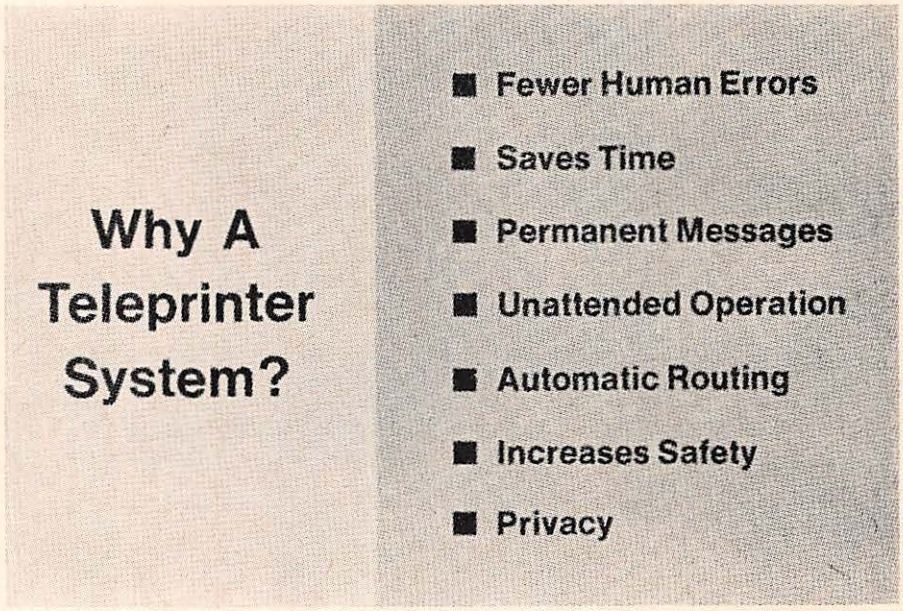
Radio keys on mobile printer



VP-100 printer weighs 11 lb, and measures 4⅛" x 9½" x 10⅛".

By William M. Borman
Engineering Manager
Motorola Communications & Electronics Inc.

This is an abstract of a paper presented at the annual meeting of the Communication & Signal Section, AAR, in Dallas, Texas on Oct. 2, 1968.



There is a need for a method that will get messages to trains or crews reliably and accurately on a timely basis. The answer is a small, rugged, reliable mobile printer capable of receiving and printing messages accurately in the rugged railroad environment. Printed communications to units in the yard or along the right-of-way potentially have many advantages that can be realized now.

(1) An obvious advantage—there can be no misunderstood sounds, no dependency on clear enunciation, no need to take the mind off the problem at hand.

(2) Writing down messages by hand is very slow-typical writing rate is 20 words per minute. Typical is 100 words per minute printing rate of mobile printer systems. Consequently, time is saved by both the dispatcher and the crew foreman. Radio "air" time is conserved. The job can be accomplished faster with complete knowledge of all the facts.

(3) Since the messages are printed, a permanent record is available for reference. There is no need to commit facts to memory or refer to longhand notes.

(4) The message is received even if the locomotive, caboose, or other vehicles are unattended. When the crew member returns to his vehicle, the message is available, conserving valuable dispatching time. He can check it out, acknowledge it, and respond to it.

(5) With automatic mobile teleprinter message routing, the messages go only to the locomotive to be contacted. This feature permits automatic message routing by card readers, teletype machines, or computers, since the address can be a part of the message format.

(6) Safety is enhanced since there is no need for the crew foreman's attention to be distracted to take down a message.

(7) There is less chance of a message being misinterpreted as being meant for someone else as might happen with voice systems. The printer message is sent in tone form which is unintelligible to the human ear. Only the addressed printer responds to the tones by printing out the message.

A mobile teleprinter system can be used for many different types of special and routine communications that can be sent faster in printed form thus providing more available radio time for other voice radio communications.

The Motorola VP-100 printer system is comprised of two basic units, the printer control terminal (base station) and the mobile printer.

The printer control terminal, as shown in Fig. 1, is associated with the base station transmitter and accepts 5-level Baudot or 8-level ASCII coded information from a punched paper tape, or 8-level ASCII coded information from a teletypewriter, data card reader, or other data terminal. The incoming information is accepted into memory at rates of up to 100 words per minute, until a full character line (up to 36 characters) is received and stored. Each set of character signals is then translated into a 5 x 7 dot matrix; the matrix information is shifted serially to an audio tone modulator. The output of the modulator is applied to the audio input of any standard base station transmitter for radio transmission to the mobile. The terminal design incorporates control signals to the data source terminals to achieve full duplex operation,

and also provides pushbutton controls to allow for selective addressing of printer(s) on an individual, group or all-call basis.

The mobile printer (VP-100) interfaces directly to the discriminator output of a mobile receiver. The incoming tone information is demodulated and converted to a parallel form. The parallel data is used to control print bars, synchronize a control motor and position a helix platen to reproduce the transmitted dot matrix characters. Automatic signaling is provided to achieve position control for the start of each printed line. Selective address decoding is incorporated to allow for discriminatory printing if so desired.

The VP-100 printer system utilizes an audio tone oscillator to generate two tones of the same frequency, each of which is 180 deg. out of phase with the other. The radio transmitter is modulated by on-off keying of the two tones with only one of the two tones modulating the transmitter at any instant. The transmitted data rate is approximately 800 bits per second. The information bandwidth of the transmitted signal is that of a standard 3 kHz voice channel.

The system concepts for application of mobile teleprinters to railroad communications are directly influenced by present and future operational requirements. Currently, the communications requirements to the crew members in locomotives, cabooses, and maintenance of-way vehicles is provided by voice-based radio communications systems. The operational characteristics of these systems have an important bearing on the design of the mobile teleprinter communication systems.

A communications system for yard operations is portrayed in Fig. 2. The yardmaster or train master in this system has switch lists in the form of data cards. He uses the card information as his switch list to send to the switch engines. The yardmaster communicates with crew foremen in radio-equipped locomotives and car inspectors with portable radios. The locomotives also have mobile printers.

When the yardmaster is ready to send a switch list to a switch engine, he inserts the data card or cards into the card reader. Then he manually punches the number of the switch engine he wants to direct the message to on his selective address unit. Then when he actuates a start button, the printer control terminal automatically turns on the base station and the switch list is transmitted to the printer in the selected switch engine. The base station is turned off automatically after the last data card has been read and the information has been transmitted to the switch engine. The system then returns to the voice mode of communications and receipt of the switch list can be acknowledged by voice radio. The yardmaster controls the system transmitting voice messages or printed messages on a time-shared basis.

A communications network for a mainline operation is represented in Fig. 3. Maintenance-of-way printed communications could be accomplished in a similar way. The mainline dispatcher is connected to many VHF mainline base stations via a private microwave system and can select the mainline base station needed for communicating to a given train. The dispatcher's data input unit is a teletypewriter consisting of a keyboard, paper tape punch, and paper tape reader. He uses the keyboard to "cut" a train order paper tape with a selective address header. This header performs the same function as the manual selective address unit in the yard system. The tape is then inserted into the paper tape reader. The dispatcher selects the switch on his master console which controls the mainline station closest to the train he wants to contact. He then actuates the start button for the printer control terminal and tape reader. The mainline station transmitter is automatically turned on and the

(Please turn to page 22)

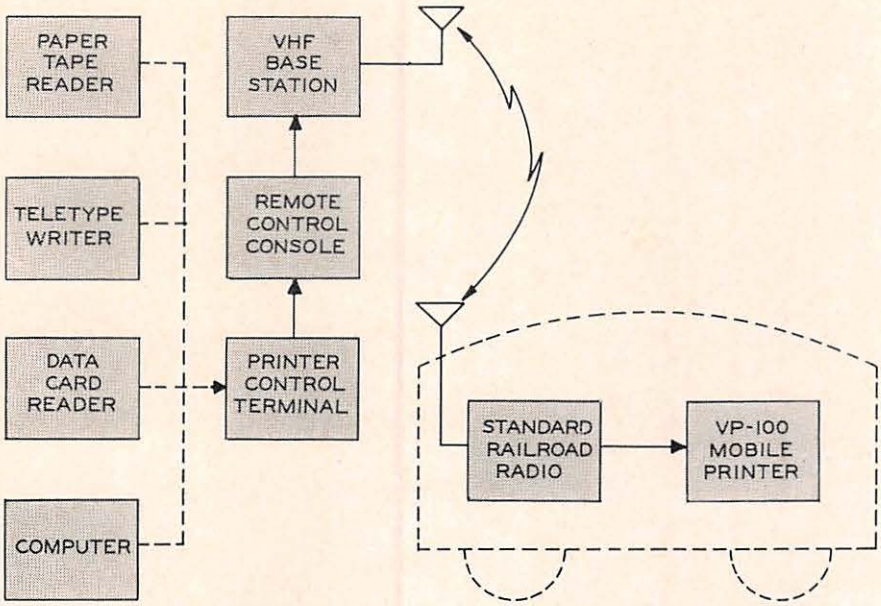


Figure 1: Block diagram of VHF radio mobile teleprinter system.

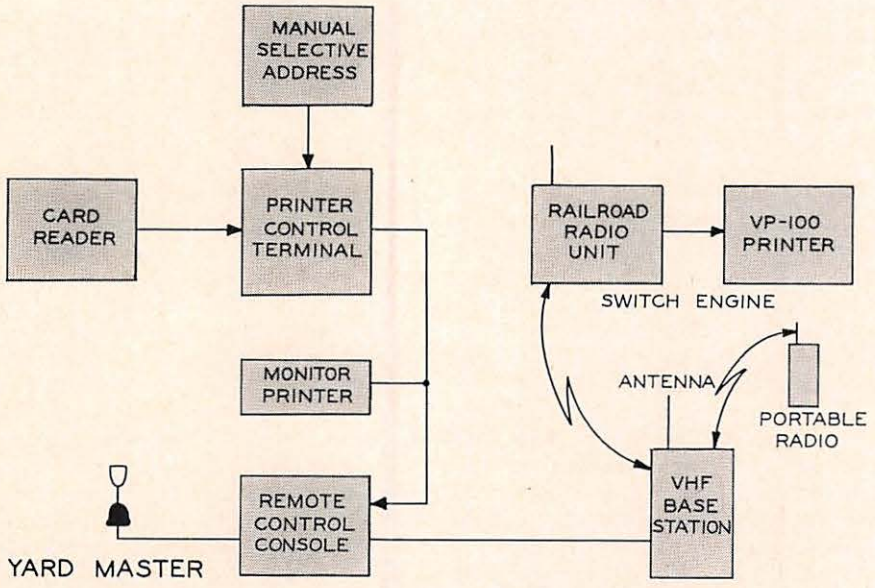
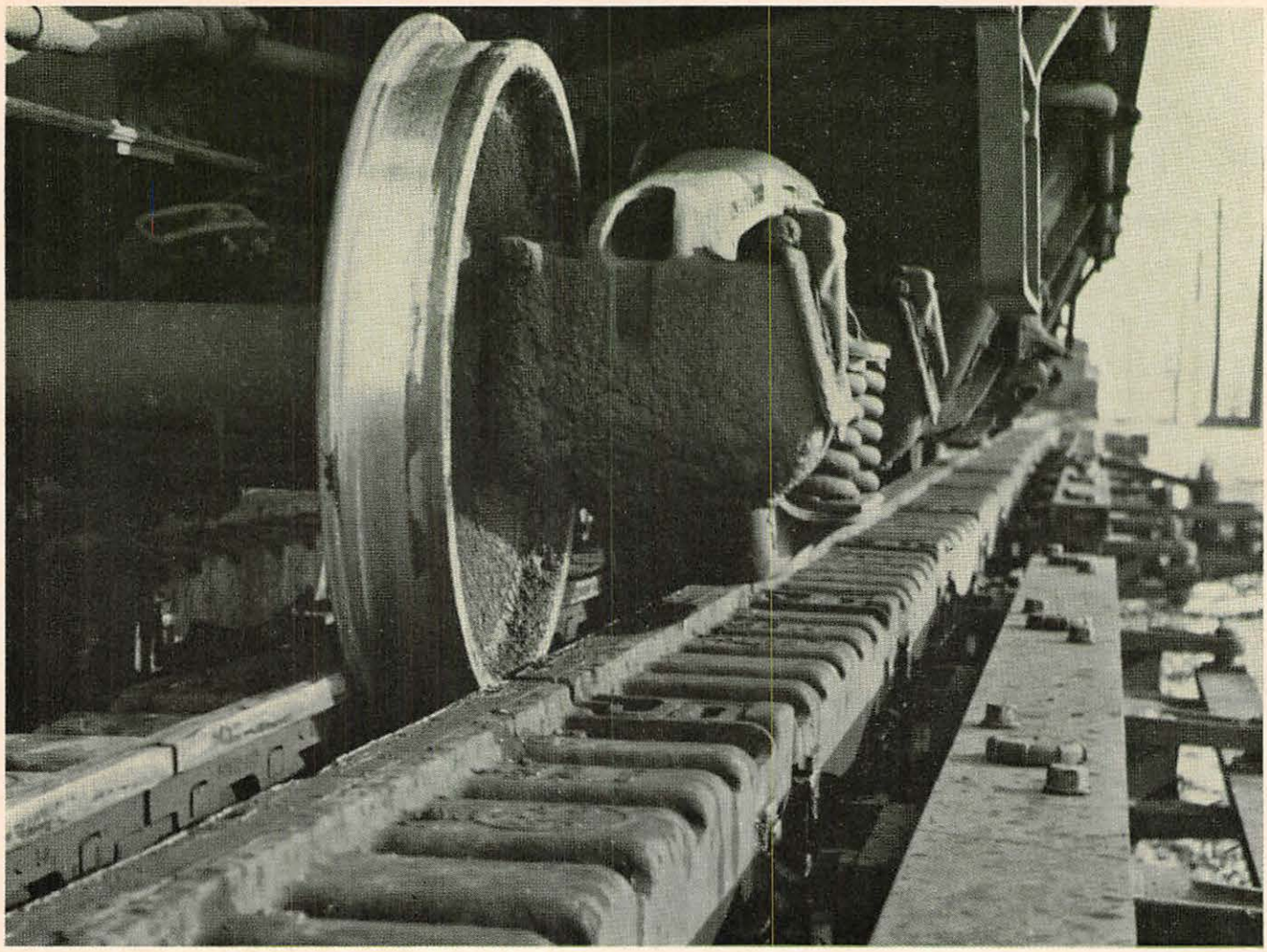


Figure 2: Block diagram of a typical yard system using the mobile printer.



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Circle 9 on reader service card on page 38

3478

(Continued from page 20)

train order is transmitted in "tone" form to the selected locomotive or caboose. In the locomotive or caboose, the tones are received and converted to the printed train order message by the mobile printer.

The selective addressing of the mobile printer can be accomplished on an individual, group, or all-call basis. Therefore, the train order could be sent simultaneously to the locomotive and caboose of the same train if a group address is used or to as many trains as required.

While this example describes a teletypewriter as the data input unit the train orders could also be generated by a computer or other data originating units.

The VP-100 mobile printer is primarily electronic in design with extensive use of integrated circuits. Its mechanical design is simple and reliable. This printer forms each letter as an array of 35 dots in a five by seven dot matrix. The dots are produced by a very simple mechanical action on pressure sensitive paper.

In the upper view of Fig. 4, the pressure sensitive paper is passing around a roller with a raised helical ridge. A plate with a wide striking bar is momentarily driven forward marking the paper with a dot as it passes between the striking bar and the raised helical ridge. The lower view shows that there are six adjacent striking bars. This means six dots can be made at once. Notice the adjacent striking bar arrangement means that printing is occurring at six different points across the page at the same time. This prints all of the top rows of dots in all the letters across a line before it goes to the second row of dots. Each line of 36 characters has five dots across each letter and thus a maximum of 36 times 5 or 180 dots may be printed in one horizontal row.

The paper feed mechanism is very simple. A slow steady stream of paper is passed up and in front of the helix roller which turns at a constant speed so that there is no stopping or starting of the paper and no carriage return to add mechanical complexity. The striking bars are also fixed in position. The drive for a striking bar is provided by a piezo-electric ceramic crystal which flexes when pulsed by electrical signals. This causes the bar to strike the paper. This design provides reliability through simple mechanical design with all possible functions being performed electronically using solid state integrated circuits.

There is no threading of paper when reloading. The helix roller is raised and the new roll is laid in place. The important mechanical items are identified here:

Two types of pressure sensitive paper can be used, a wax coated type or ink encapsulated paper. The stepping motor is a brushless type that is synchronized by the transmitter to advance the paper and rotate the helix at essentially constant speed.

Integrated circuits are used to reduce the size of the printer and at the same time provide the high reliability required in mobile service.

Mobile radio transmission takes place in a constantly changing environment of both natural and man made noise and electromagnetic obstacles. The radio transmission medium is subject to noise, fades, and standing waves, and is sometimes a poor carrier of voice as well as data communications.

By printing rows of dots across the entire page all at the same time, a noise burst introducing errors will be spread across the page instead of corrupting or obliterating a single letter. While a single wrong letter can change the meaning of a word and perhaps a whole message, a burst of wrong dots across a line has little effect. This concept of "dot error dispersion" gives the highest level of probability that the message will be received accurately at the mobile unit under adverse signal conditions.

- The VP-100 is intrinsically simple in both its mechanical and electronic design. Only five basic elements are incorporated into the printer.
- The VP-100 is the smallest page-

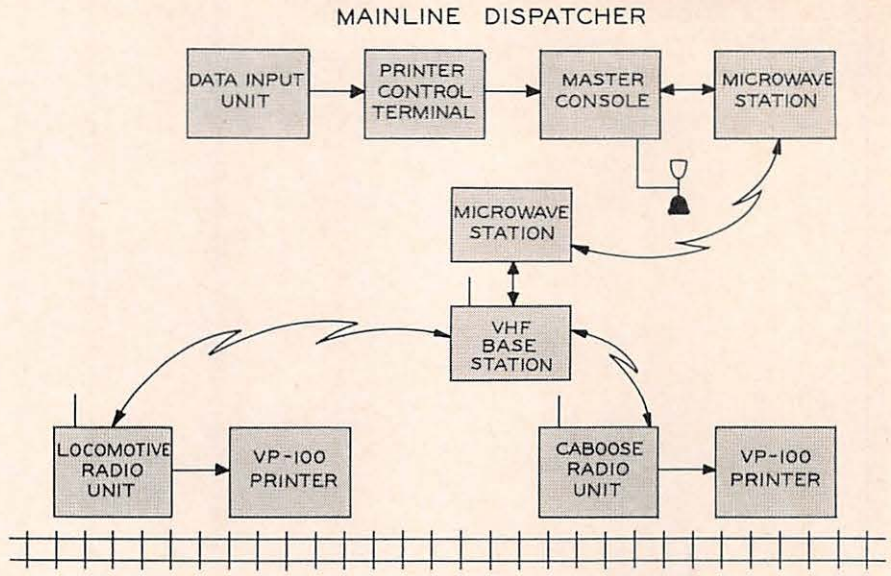


Figure 3: Typical mainline railroad radio system using mobile printers.

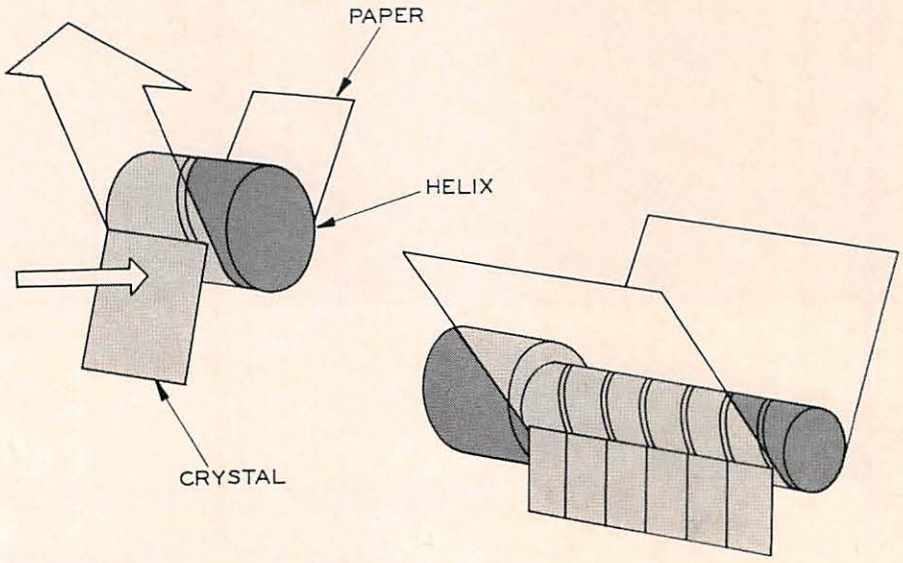


Figure 4: Basic parts of the printer are crystal, helix and paper.

type printer designed for use in vehicles. The unit weighs less than 11 lb. The dimensions of the unit are 4⅛" high and 9½" deep, by 10⅛" wide.

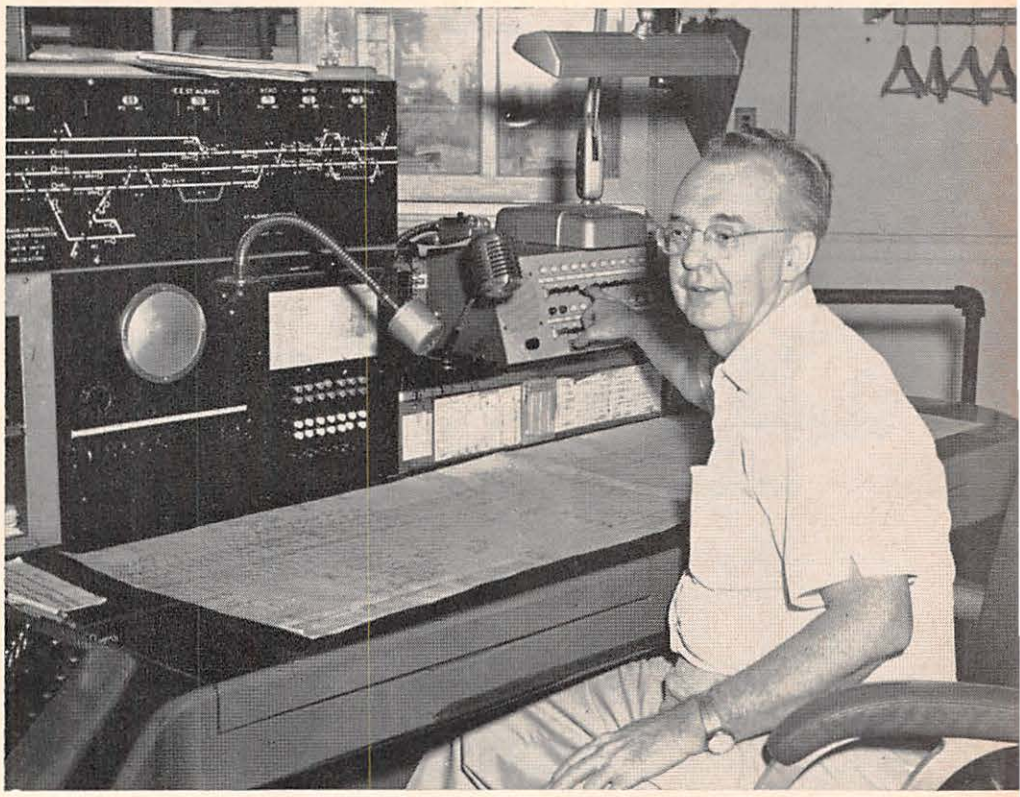
- Extensive use of integrated circuit technology insures high reliability. The latest state-of-the-art components are used in both the printer control terminal logic boards as well as in the logic and timing circuits in the printer.
- Low battery drain minimizes power consumption. This is important when the vehicle is unattended. In the standby mode only 200 ma are required. In the print mode only 1.5 amp is necessary.
- Messages are accurately received due to the unique printing concept. Noise bursts will not destroy the integrity of messages, since "dot errors" are dispersed across the page.

The selective addressing option allows individual units, groups of vehicles or all vehicles to be contacted. Only those personnel who need to get the message will be alerted.

- The VP-100 is designed to operate without printing failures under the typical shock and vibration conditions found in railroad services. This is a must.
- A dual intensity copy light is provided so that messages can be read easily at all times.
- A power switch and power on indicator are provided to permit selective use of the printer.
- A thumb wheel is provided so that the paper roll can be manually advanced if the operator so desires.
- The paper roll can be easily changed. No technical skills are needed.
- Finally, lubrication of the printer is not required. It is designed for long life and absolute minimum of maintenance.

At the present time, teleprinter systems can be licensed only on a developmental basis. FCC has issued a "notice of inquiry" for radio teleprinters in order to obtain information for modification of existing rules. Railroad organizations appear to have a need for mobile teleprinters in their operations; accommodation by appropriate FCC rule modification is necessary for railroad printer systems to become a reality.

Only a few possible uses of mobile teleprinters have been discussed. Analysis of information actually transmitted to trains or maintenance crews may provide many more candidate uses. An effective system most broadly serving railroad operations must be supported by detailed planning. Then flexible systems can be designed to obtain the maximum benefits of data form communications. Radio teleprinter systems can provide many benefits unobtainable in voice radio systems.



Dispatcher can select several wayside VHF radios by toggle switch operation.

Radio stations have digital controls

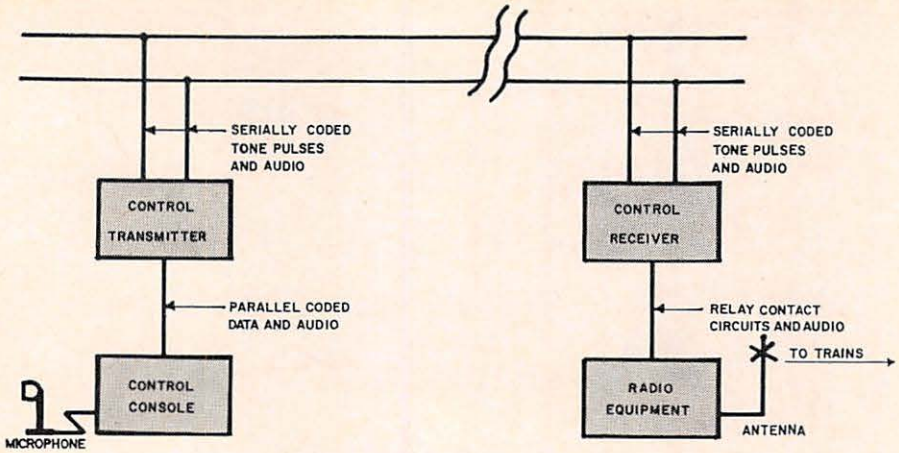
Chesapeake & Ohio has installed a digital remote control data system specially designed for railroad applications. It has been thoroughly tested by the C&O/B&O for more than two years, and is now being used to control wayside VHF base radio stations from the dispatcher's office in Charleston, W.Va.

The system differs from earlier base station remote control systems which employ electro-mechanical selectors or frequency-selective vibrating reed relays. This new system will operate over open wire lines, telephone cables, carrier telephone channels or microwave multiplex channels. It employs solid state digital and analog modules and computer techniques to ensure positive performance and no need for adjustments. It has proved to be completely reliable and operable when line noise conditions were so severe that speech transmission was not possible.

This digital system is comprised of a control receiver located at each of the wayside base stations and a dispatcher's control console and control transmitter at the dispatcher's office. The system is designed to provide supervisory control and alarm facilities over existing voice band circuits without interfering with the services carried by the same circuit. The voice-band is notched at 2400 Hz to permit simultaneous transmission of the digital codes and voice without interference to or degradation of voice transmission.

The dispatcher depresses individual key switches to select, operate or mute any wayside radio station. He receives visual acknowledgement that his commands have been received at the selected station. The dispatcher can accomplish the following: (a) receive radio transmissions through any or all wayside radio stations, either individually or simultaneously; (b) transmit over any one station or all stations simultaneously; (c) automatically mute the radio receivers at the stations adjacent to the one being used for transmission; (d) mute a defective radio receiver at any station without affecting the others in the system; (e) activate relay controlled functions at remote stations.

Three types of functions can be effected at the remote stations.



Block diagram of the digital control system for wayside radio stations.

(1) Fully automatic functions that are wired into the remote receiver, requiring no initiation by the dispatcher. Typical functions in this category are automatic mute of all radio receivers when the dispatcher initiates the push-to-talk function at any remote station; automatic muting of radio receivers on either side of the addressed station to avoid "echo" resulting from adjacent radios picking up the same incoming transmissions. The system is not limited to just the functions cited above; they are mentioned as examples of types of functions in this category.

(2) Semi-automatic functions which, when activated remotely by the dispatcher, will automatically return to their quiescent state upon receipt of a "clear" signal from the dispatcher's station. Examples of these functions are: station address, which when properly decoded by the receiving station primes the station for all function commands such as change of channel for multiple-channel stations, etc.

(3) Discrete lock functions that are not de-activated by the "clear" command but require discrete "set" and "reset" commands from the dispatcher's station. An example of such a function is the "unconditional" mute which is required to restore the communications circuit when made unusable due to excessive noise introduced by malfunction of the squelch circuit of one or more of the remote radio receivers connected to the circuit. The dispatcher can mute an offending receiver by addressing each receiver and muting and de-muting them in sequence until the noise has been eliminated. This identifies the defective receiver and locks its muting circuit until investigation and repair of the offending receiver can be accomplished, after which the receiver can be re-stored to normal operations. The examples mentioned are just a few of the many functions that can be performed by this new digital remote control data system.

A 15-bit digital code for recognition, address and function command is employed to key a crystal controlled 2400-Hz tone generator. Commands are generated as parallel data, converted to serial data and then transmitted as a single coded tone burst. At wayside stations, the serial coded tone bursts are converted back to parallel data and used to drive the decoding logic circuits and control relays. Only one-tenth of a second is required to transmit the 15-bit code. The first 7 bits of the code effect recognition and perform housekeeping services at a station receiving the signal. The next 5 bits form the address code and the following 3 bits form the function command.

The combination of address and function codes may be changed from that outlined in the examples given above. It is possible to adjust for any combination of bits to be assigned for address and function. The system can be expanded to handle combinations of 45 addresses and 45 functions. In order to ensure validity of the command code, each bit is precisely timed so that it will not be longer than the first 16 cycles of the 2400-Hz tone burst. Each 15-bit code requires 100 milliseconds for transmission. Unless the bit length and recognition code are free from errors the code will not be accepted by the control receiver. The coded tone bursts are repeated as long as the function command key is operated thus providing repetition of the command signal for acceptance by the control receiver.

One of the most significant features of the system is its ability to handle a large number of remote control commands and supervisory reply signals on a fail-safe basis. Even though the C&O/B&O is using the system only for remote supervisory control of wayside VHF base radio stations, it can be used for many other remote control and supervision applications.

The equipment, including the solid state modules were developed and are being manufactured by Electronic Modules Corp. Overall system planning was supervised by Howard Alford, assistant communications engineer of the C&O/B&O under the direction of Paul A. Flanagan, superintendent of communications.

View from the Crossarm

Switching from book reviews, this month's View will present some ideas and thoughts on recruiting and training of employees. These comments are not new or original, but merely are presented with the thought that some readers may find them helpful.

On recruiting college men for signal and communciations departments it takes time to win the confidence and support of college placement officers, particularly when trying to get graduates to go to work for a railroad. Additionally, some S&C officers are finding that these placement officers do not understand why a railroad needs electrical engineers. One road's S&C officer found it took about three years' effort in order to have college placement officers on the lookout for and actively recruiting men for railroads.

From conversations with S&C officers, it appears that most railroads starting salaries for graduate electrical engineers are in line with industry in general—about $700 per month. The big hang up as far as railroads are concerned is that the college graduate expects to be making $1,000 a month in about 5-6 years.

It appears that one of the problems in keeping graduate electrical engineers is in expanding the pay brackets. This is a battle with management that must be won if railroads' S&C departments are to have the trained engineers for the rapidly advancing technology that they must apply.

One way might be to use engineers for engineering work, and try to use technicians for as much work as possible not requiring the electrical engineering education. Another method might be to use standard circuits as much as possible in S&C work thereby reducing circuit design work to only those instances where standard types are not applicable. Such standardization might well reduce the work load on circuit designers and draftsmen.

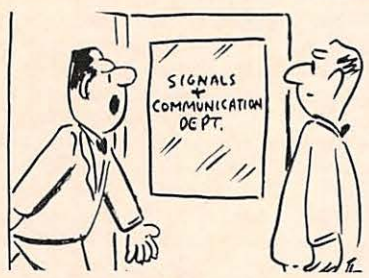
For recruiting at the technical levels, such as maintainers, some roads are finding conventional highschool graduates can be technically trained to become competent signalmen, maintainers and technicians. To be a radio maintainer, electronic technician at a retarder classification yard requires an FCC radio-telephone license of second class or better. Some roads are able to hire technical school graduates, while others have tuition refund plans for men who qualify by taking courses at technical schools, either locally or by correspondence.

But keeping the technically trained man, be he at the tecnician level or a graduate engineer, is much the same. One large western railroad that has not had the problem of losing its technically trained men assigns these reasons for the good fortune: interesting and varied work assignments; competitive pay scales with industry including pension plans and occasional travel at company expense; plus a departmental and railroad "esprit de corps" that has given the men pride in belonging to a "winning team."

While some may jeer such terms as esprit de corps or company spirit, it does work. It appears to be one of those intangibles that keeps a man on the payroll doing a fine job for one company, when he could command a much higher salary outside in another industry.

Admittedly, many of the railroads with this fine esprit de corps and good company men turn out to be ones that have provided training for S&C employees below the college level. In some cases, it has meant a team effort, namely the S&C officers selling management on the importance of such training. Often he has found willing allies in the road's personnel department, among union officials on his road, and naturally the support of S&C employees involved.

One approach might be for S&C officers to contact chief mechanical officers about apprentice training. On many roads, an apprentice training program is in force for carmen and diesel mechanics. If it works in the mechanical department, it certainly ought to work in the signal and communications department. Naturally, the S&C training can't be a carbon copy, but it's worth looking into. Also, S&C officers might talk to data processing supervisors because many of the latter have the problem of retraining clerks when new computer methods are instituted. Many departments other than S&C provide training for employees. S&C officers might do well to find out about these programs.



"Our signals of the future are now signals of the past."

Product News

Data Set

Two new data sets which provide full duplex transmission of data at speeds up to 300 bps are known as L2103A and L2103F. Both of these data sets meet EIA standard RS-232B interface between business machines and data sets. These units are forerunners of a complete line of data sets, fully compatible with equivalent Western Electric type data sets. The L2103A data set will provide for alternate voice and data communications between telephone stations. The L2103A data set will provide full duplex operation on a two-wire voice facility at rates up to 300 bps for data service and 150 bps for telephone service. *Lynch Communication Systems. Circle 101 on Reader Service Coupon.*

Switch Heater

A new line of gas fired switch heaters have three basic models which operate on propone gas exclusively and have the same orifice (.040" diameter). Proper firing rates are obtained by means of a simple gas pressure adjustment.

The Sno Gard heaters have side mount brackets which fasten the unit to the ties. The heaters are available in manual or AC/DC automatic operation. The control box for automatic manifolds may be used either on AC or DC type heaters, with one simple adjustment. The automatic manifolds now come with On/Off solenoid valve. Optional equipment includes a snow detector to assure immediate light-up on sensing the presence of falling or drifting snow or freezing rain. Rail temperature control unit saves fuel and prevents overheating of rails. The Sno Gard heaters have controlled heating by conduction, convection and radiation. *Vapor Corp. Circle 102 on Reader Service Coupon.*

Selector Control

The 415-2 is a solid-state selector which adapts almost any teleprinter for operation in a Bell System 83B3 selective calling system. Standard arrangements are made for five-level Teletype code, polar or neutral operation, repeneration of line signals to station when selected. Two separate speeds are adjustable from 60 to 100 wpm.

The unit consists of the standard 421 style Pulsecom chassis and the 420 series components: power supply, 5-level signal distributor, decoder card (16 characters) sequence card and a control card that applies the selector to 83B3 format. *Pulse Communications Inc. Circle 103 on Reader Service Coupon..*

● ANTENNAS: Antennas, transmission lines, duplexers and cavities are described in catalog No. 12. Antenna systems not only include VHF radio, but microwave antennas as well. Physical descriptions, characteristics, photographs, drawings, and electrical specifications are included. *Decibel Products Inc. Circle 104 on Reader Service Coupon.*

● TRACK CIRCUIT: The short range track circuit is a high frequency audio transmitter-receiver designed for grade crossing island circuits at highways, electric switch lock release, detector circuits, hotbox detector control and sharp cutoff minimum distance with the grade crossing predictor. A description and specifications of this model 185 SRTC is provided in catalog 15. *Marquardt Industrial Products. Circle 105 on Reader Service Coupon.*

● DATA STATIONS: Bulletin 7000 describes series DS-7000 and series DS-9000 keyboard oriented data stations for putting data directly onto computer compatible magnetic tape. Combined keypunch, keyboard, alphanumeric display, core memory, and magnetic tape convenience provide 30-40% improvement in operator productivity. Optional features include self check digit, odd parity or even parity, 64 character keyboard, end of file recognition, expanded memories etc. *Sangamo Electric Co. Circle 106 on Reader Service Coupon.*

Video Tape Recording

A battery-operated video tape recording system uses a closed-circuit TV camera only slightly larger than a home movie camera. The system is completely portable with a ½" tape unit that records both sight and sound. Instant playback can be

(Please turn to page 26)

(Continued from page 25)

provided on any GE ½" VTR recorder deck. The hand-held TV camera weighs less than 5 lb and has a small removable microphone mounted on top to record voices or background sounds. A 1" viewfinder serves as a small TV screen to show the cameramen the action being recorded. The camera has a zoom lens.

The video tape recorder is carried over the shoulder and is linked to the camera by a single cable. The recorder unit weighs about 10 lb, complete with two rechargeable batteries. A battery charger is included in the system. Overall weight of the complete GE Porta-Pack system is less than 15 lb. An instant playback unit comes separately with either 11" or 22" screens.

The small battery-operated camera is completely solid state except for viewfinder and vidicon tube. The former has an adjustable eyepiece and measures 1.3" diagonally. The zoom-type lens is 16-64 mm, and at F2 rating.

Video recording system is helical scan with fully automatic video and audio level controls. Operating speed of the ½" tape is 7.5" per second with 20 minutes recording on each 5" reel. Two rechargeable batteries permit about one hour of recording time. Approximately eight hours are required for recharging the batteries. *General Electric Co. Circle 107 on Reader Service Coupon.*

Power Meter

A new microwave power meter can operate with zero carryover from range to range and stay within ¼%. With its associated thermistor mounts, the new power meter, model 432A, can measure power from 10 mHz to 40 GHz. Accuracy is 1% of full scale and all power ranges over a broad 0 to 55°C temperature range. Full-scale measurement ranges for the new power meter are from 10 microwatts to 10 milliwatts. Measurement of signals as low as 1 microwatt can be made. *Hewlett-Packard Co. Circle 108 on Reader Service Coupon.*

● WIRE & CABLE: General descriptions along with electrical characteristics and configurations of plastic insulated telephone cable, as well as color coding information and paper insulated telephone cable is provided in a wire and cable catalog CPD6606. Additional specifications, descriptions and information is provided on plastic insulated aerial drop wire and coaxial cable. *Communication Products Division, Anaconda Wire & Cable Co. Circle 109 on Reader Service Coupon.*

Test Set

A new test set for field testing of data modems, model 110, weighs only 8 lb and measures only 3" high and 12" wide. The Milgo test set, model 110, evaluates data transmission systems using synchronous modems operating at any speed from 10 to 10,000 bps which are equipped for RS232B V.24 interface, supplying their own clock. The model 110 allows data processing equipment to operate normally during the testing period. The self-contained unit connects directly to the data modem, providing a 2047 bit pseudo-random pattern for transmission. It synchronizes itself with the received digital data stream, detects errors and displays these errors on front panel lights. *Milgo Electronic Corp. Circle 110 on Reader Service Coupon.*

Flange Detector

The model 4040 wheel flange detector comprises a self-generating inductive pickup plus electronic circuitry to interpret that the generated voltage is linear in relation to the speed and proximity of a wheel above the detector. The detector will indicate passage of wheels at speeds from ½ to over 200 mph. Both output pulse amplitude and pulse length are independent of train speed and can be selected for positive relay control or input to high speed computers.

The pickup head of the wheel flange detector will fit on any rail from 155 lb down to 80 lb. Power requirements range from 95 to 120 volts, 50 to 60 Hz at 35 VA and the unit will operate a temperature range of −45 to +135°F. Output relay is 5 amp dry contact 125 VA rating or pulse of −26 volts ±1% from 1 millisecond to 15 seconds. *Erico Products Inc. Circle 111 on Reader Service Coupon.*

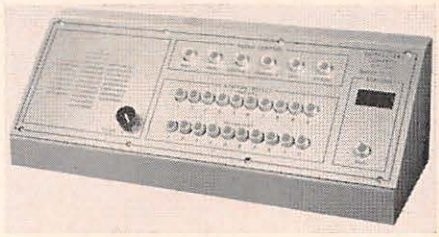
Data Sets

Three series of data sets offer up to 2400 bps transmission speed to handle serial binary data over voice bandwidth circuits. The AE2024 is non-synchronous frequency shift keying binary data and operates at any information rate up to 1600 bps. The AE2025 is synchronous FSK binary and operates at fixed information rates of 600 or 1200 bps. The AE2026 data set is synchronous FSK duobinary and operates at fixed information rate of 2400 bps.

AE data sets can be equipped for half-duplex, full-duplex or one-way operation. Standard interface provides compatibility with many different kinds of business machines and data processing equipment: computers, magnetic tape terminals, keyboard printers, visual display units, etc. Line connection utilizing the line core furnished is applicable to either 2-wire or 4-wire, 600 or 900 ohm impedance. *Automatic Electric. Circle 112 on Reader Service Coupon.*

Facsimile

A system for handling facsimile transmission of 8½" x 11" documents at a speed of six minutes per page is called the Xerox telecopier. The system operates over conventional telephone lines and has electrical requirements of 115 volts, 60 Hz, 3 amp. *Xerox Corp. Circle 113 on Reader Service Coupon.*



Way-Station Control

A new system for way-station calling and wayside radio control operates by the use of two-tone signaling and can be used on open wire lines, cable, microwave or leased circuits. The console enables the dispatcher to select up to 85 codes on the system. For way-station operation this enables the system to signal 85 drops from the dispatcher's console. If wayside radio is incorporated into the facility, 26 of the selections would be reserved for operation of radio units. In addition to selective calling for way-stations or radio base stations, the system incorporates the standard radio functions such as channel change, press-to-talk, over-ride, protective timers, etc. *Bayly Engineering Limited. Circle 114 on Reader Service Coupon.*

Subscriber Carrier

The S6 subscriber carrier system provides 6 channels on 1 wire pair. Each of the 6 channels, in one system, can be used for 1, 2, 4 or 5 party service, providing a total of 30 potential stations on a line. The central office power supply provides DC power to all repeaters and subscriber terminals through the pair. Automatic gain control and automatic level control allow subscriber terminals to be located anywhere within 40 dB of the central office or 35 dB of a repeater. They can even be dropped in between repeaters or between the central office terminal and a repeater. Each channel has an integral 30 dB 2:1 compandor, providing improvement over non-compandored AM systems.

S6 repeaters handle all 6 channels in both directions with up to 3 repeaters in tandem. Any high impedance, frequency-selective ringer can be used with the S6.

The subscriber loop is 300 ohms. The bandwidth is 300 to 3,000 Hz plus 1.5 dB or —2.5 dB relative to reference level at 1 kHz. *Anaconda Electronics Co. Circle 115 on Reader Service Coupon.*

Frequency Counters

The TTS 80 series of frequency counters and timers operate up to 10 mHz. Each model features balanced input, high sensitivity, high bridging impedance, selectable input impedances and telephone type input jacks and terminals. All models feature a switchable input transformer for use under conditions of high longitudinal noise. *Northeast Electronics Corp. Circle 116 on Reader Service Coupon.*

● DATA SET: The T401E data set transmits parallel data codes over regular telephone lines or private lines at rates of up to 20 characters per second. The unit transmits data signals from card reader or numerical keyboard and converts these signals to tones for transmission over switched or private telephone networks. The unit provides two-way voice communication with a data center and then, at the touch of a button, switches to data communication. Specifications as well as a description of the set is given in bulletin 5301. *Sangamo Electric Co. Circle 117 on Reader Service Coupon.*

VF Equipment

The KMT series features a complete line of voice frequency terminating equipment, networks, audio amplifiers, equalizers, and signaling modules. It combines communications and switching design engineering to fulfill the requirement of most any signaling and terminating combination in a standardized package. Plug-in modular construction of all units makes replacement quick and simple. The components of each unit are mounted on an etched-wire printed circuit board which plugs into its connector, mounted in a common shelf. Up to twelve single-spaced units can be accomodated in only three mounting spaces on a 19" rack.

Some of the equipment included in the KMT series is 4-wire to 2-wire terminations, 4-wire to 4-wire termnations with and without signaling, and amplifiers, jack panels, oscillators and power supplies. *Kellogg Transmission Products Department. Circle 118 on Reader Service Coupon.*

Multiplex Systems

The K65 multiplex systems provides for toll grade transmission of voice, program, telegraph, data, telemetry, facsimile, and remote control signals. The K65A is designed for high density systems with large initial channel requirements and is expandable to 960 channels. The K65B system in this series provides up to 24 voice channels and requires less than 60 watts of DC power for a 24-channel system with out-of-band signaling. *Telecommunications Div. ITT. Circle 119 on Reader Service Coupon.*

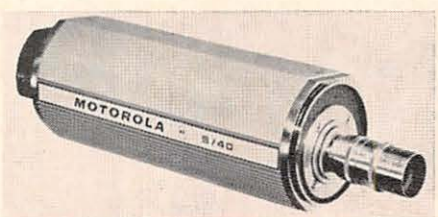
Coaxial Cable System

The LF4B system provides trunk telephone circuits over two 4.4 coaxial tubes. Up to 960 telephone circuits can be so accommodated. Dependent repeaters are spaced approximately 2.5 miles apart. Protection is provided against surges induced from lightning or other sources of interference. Two alternative systems are available. One, the LF1A, provides 300 circuits operating over the 4.4 mm cable and repeater spacing is 3.6 miles. The other is the LF4A which is 960 circuits operating over a 9.5 mm cable with repeater spacing of 5.7 miles. *Standard Telephones & Cables Ltd. Circle 120 on Reader Service Coupon.*

Telephone Control

The EXEC VP-1 telephone control head replaces a standard microphone speaker in a two-way radio unit in an automobile and converts it into a mobile telephone. A self-contained solid state digital decoder responds to 7-digit national or 4-digit local calling numbers. When connected to a duplex two-way radio, the EXEC VP-1 locks on the mobile transmitter to eliminate the need to push-to-talk and release-to-listen. Standby operation, with the key removed, leaves the receiver and decoder ready with a minimum battery drain to take and hold calls while preventing unauthorized use of the radio. *Secode Electronics Circle 121 on Reader Service Coupon.*

● CABLE PLOW: "Railroad cable can best be buried by plowing" accurately describes a 4-page illustrated brochure of a new method of plowing in underground cable along railroad rights-of-way. A plow mounted upon a flat car and is pulled by a locomotive with a trailing gondola holding cable reels. *Henkels & McCoy. Circle 122 on Reader Service Coupon.*



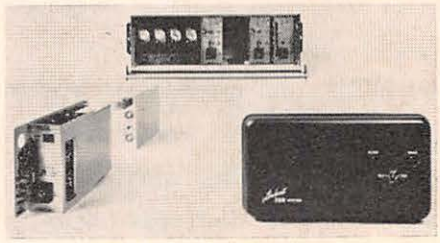
TV Camera

A new solid state 800 line resolution closed circuit television camera is now available. It has automatic light compensation, electronic focus regulation and is housed in an extruded aluminum chassis. Horizontal resolution in excess of 800 lines at light levels as low as 10 ft candles can be provided. Only 1 ft candle of incident scene illumination is required to provide a visible picture with 700 lines of horizontal resolution. Power input for the camera is 117 volts, 60 Hz, 18 watts. Weight of the unit is 10 lb and it is for conventional mounting on a standard tripod. *Motorola Communications & Electronics Inc. Circle 123 on Reader Service Coupon.*

Snow Detector

The model 4030 snow detector will detect the presence of snow, sleet or rain if ambient air temperature is below 37°F. The detector head may be mounted on base of rail, but it should be so located that any heat transferred to it will come only after the track is warm, because the detector is usually installed to operate in conjunction with switch heaters. It should not be located where it would quickly warm up and thus shut off the heaters before the snow had been melted from the area of the switches. *Erico Products Inc. Circle 124 on Reader Service Coupon.*

● STUNT BOXES for providing sequential selection for teleprinter switching networks are described in bulletin F400-1A. A new modular system of digital, etched circuit function cards that slide into a choice of standardized chassis can provide a variety of control and selector arrangements for 5-level and 8-level teletypewriter equipments. *Pulse Communications Inc. Circle 125 on Reader Service Coupon.*



Data Sets

A new low-speed data transmission system has plug-in filters to provide a wide choice of channel spacings and related data speeds—from 120 Hz for 75 b/s to 1020 Hz for 600 b/s. The new system, the 25B, will operate over cable, open wire and microwave/multiplex systems, microwave supervisory channels, or over physical voice frequency circuits. The system can be arranged for either two or four-wire circuits.

Operating over a standard voice frequency facility, up to 25 channels can be provided with a bit rate of 45/75 b/s. If the speed is increased to 110 b/s up to 18 channels can be provided; 12 channels would operate at 150 b/s; 9 channels would operate at 200 b/s and 1 channel would operate at 600 b/s. Also, 13 more 200 b/s channels can be located above the voice range to 8 kHz if the transmission facility will accept the additional bandwidth.

The 25B has equipment arrangements for teletypewriter, data and three-frequency, three-state supervisory control. *Lenkurt Electric Co., Inc. Circle 126 on Reader Service Coupon.*

(Please turn to page 29)

Data Modem Characteristics

Prepared by Leo J. Ritter Staff Engineer, Communications & Signals, Penn Central. Reprinted by permission of George McCann, Secretary, Communication & Signal Section, AAR.

Manufacturer	Bell System	Bell System
Model	603B Data Set	603C Data Set
Transmit and/or receive	Receive	Transmit
Full and/or Half Duplex	Half duplex	Half duplex
Dial up or Private Line Application	Dial up	Dial up
Turn around time (HDX)	Not applicable	Not applicable
Automatic answer capability	No	No
Type modulation	Frequency shift	Frequency shift
Operating Frequencies	1700-2200 Hz	1700-2200 Hz
Clock, internal or external	None	None
Loop back testing feature	No	No
Error rate	—	—
Error detection and/or correction	—	—
EIA RS-232-B interface	No	No
Bit or character rate	Not applicable	Not applicable
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	900	Acoustically coupled
Impedance to data equipment, ohms	100,000	100,000
Voltages to and from data equipment	±2 volts	—
Frequency stability	—	—
Level stability	—	—
Output levels to line, dbm	Not applicable	−10
Input levels from line, dbm	Min. −40	Not applicable
Line requirements, frequency response	Voice grade, to 2.8kHz	Voice grade, to 2.8kHz
Line requirements, envelope delay	Voice grade, to 2.8kHz	Voice grade, to 2.8kHz
Line requirements, impedance	Voice grade, to 2.8kHz	Voice grade, to 2.8kHz
Line requirements, signal to steady noise	Voice grade, to 2.8kHz	Voice grade, to 2.8kHz
Line requirements, signal to impulse noise	Voice grade, to 2.8kHz	Voice grade, to 2.8kHz
Method of operation	2 wire	2 wire
Temperature and humidity limits	—	—
Power requirements	117 volts	Battery
Dimensions and weight	15" x 6" x 14", 15 lb	3.5" x 3.5" x 3", 3 lb
Digital or analog	Analog	Analog

(Continued from page 27)

Speech Plus Terminal

Voice frequency data may be alternated with voice information, thus providing voice-alternate data service below the cutoff frequency, approximately 3 kHz and full period data channels above the cutoff frequency in a new speech plus terminal. When desired, data channels may be inserted within the voice bandwidth by using standard band elimination filters. Available signaling arrangements include 20 Hz, SG (DC), and E and M ringdown. Standard Quindar tone equipment is used for the data channels. This equipment is capable of 600 baud transmission. *Quindar Electronics Inc. Circle 127 on Reader Service Coupon.*

Power Supply

A telephone power supply, designed to replace batteries generally being used in outlying telephone installations, is now available in 4.5 or 6.2 volt DC output. Continuous current capability is 1.0 amp and has less than 0.4% ripple under full load. This telephone power supply has sufficient output, regulation, and filtering so that it may be used for both talking and ringing battery. *Marquardt Industrial Products Co. Circle 128 on Reader Service Coupon.*

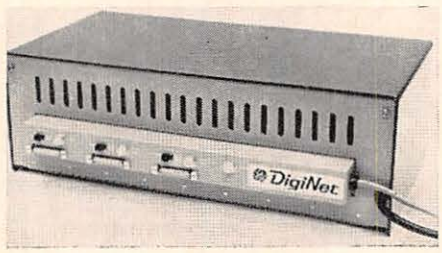
Facsimile Service

A new facsimile service is now available to 46 major cities via Western Union's Info-fax 100. It provides a transmitter-receiver over which an 8½" x 11" page can be sent in 3.6 minutes. An 8½" x 5½" page document can be sent in 1.8 minutes. The Info-fax 100 can be unattended as the receiving machine operates automatically and continuous roll-fed paper is used. Each customer station has a WU pushbotton telephone and Info-fax 100 transceiver and, optionally, an automatic answer unit. *Western Union. Circle 129 on Reader Service Coupon.*

Supervisory Control

The Datalok 7 is a modular, solid state, full duplex supervisory system for alarm reporting and remote control. The system has a capability of up to 1200 alarms provided by up to 20 alarms each from 1 to 60 remote stations. Two tone channels only are required for operation of an entire system. Optional master command capability permits up to 15 command functions at each remote station, providing a total of up to 900 possible commands. Multiple master stations permit monitoring of remote stations at more than 1 location. Teletypewriter printout can be accomodated to provide a permanent record of change-of-status of any alarm. A full print-out or interrogation of every remote station can be accomplished automatically with the teletypewriter's tape reader.

An 8-level, 11-unit code is utilized to provide synchronization and for making distortion measurements at intermediate or terminal points when operating at speeds compatible with test devices. *Pulse Communications Inc. Circle 130 on Reader Service Coupon.*



Data System

The DigiNet 150 series is a multiplex system that provides simultaneous full duplex time-sharing data communications channels onto a single voice grade telephone circuit. This GE DigiNet 150 series provides up to 15 channels on a single, conditioned voice grade circuit. It will allow a communications processor in a time-sharing computer system to transmit and receive data from many remote switched-network data sets through a single 3 KHz telephone channel at up to 150 bps. Up to nine 150 baud and up to twelve 110 baud signals can be multiplexed on an unconditioned 3002 telephone channel. The equipment also transmits necessary control signals such as ring indicator, busy out, data terminal ready and carrier detector. Solid state multiplex equipment for a typical 12-channel DigiNet 150 series data multiplex system consists of four remote buffer units at the terminal end and four computer interface units at the computer end. *General Electric Co. Circle 131 on Reader Service Coupon.*

Battery Chargers

Nife model R battery chargers are designed for highway crossing protection service. These chargers are essentially constant potential types with two position toggle switches, float and high. Input is 120 or 240 volts AC single phase, 50-60 Hz. Output is 6 amp varying from 10 to 16 volts, depending upon the types of batteries to be charged. With 10 volt output, the charger can handle 7-8 cells of nickel cadmium, 7 cells of nickel iron, or 5 cells of lead acid; at 12 volts output, the charger is rated for 9 cells of nickel cadmium, 8-9 cells nickel iron, 6 cells of lead acid. At 14 volts output, the charger is rated for 11 cells of nickel cadmium, 10-11 cells nickel iron and 7 cells lead acid. At 16 volts 6 amp output, the R-6-16 charger is designed to handle 12 cells of nickel cadmium, 12 cells of nickel iron and 8 cells of lead acid storage battery. *Nife Inc. Circle 132 on Reader Service Coupon.*

Repeater

The 305 universal regenerative repeater receives telegraph or data signals with up to 48% distortion and retransmits them with less than 1% distortion. Speeds are up to 1200 baud and the basic unit regenerates start-stop signals only. Additional units can be supplied to handle bit-synchronous signals in either a manual or automatic mode. *Pulse Communications Inc. Circle 133 on Reader Service Coupon.*

Test Generator

The test message generator TMG-3 is a small solid-state portable instrument which generates any two characters containing 5, 6, 7, or 8 information bits at speeds from 35 to 150 baud in codes compatible with serial data transmission, teleprinters, computers, telemetry systems, etc. Transmission may be continuous (alternating between the two encoded characters), or single characters may be released manually in any pattern (to simulate polling codes).

Controlled distortion may be introduced into the two character signals as marking bias, spacing bias, or switched bias. Distortion is variable from zero to 45% in 5% increments. Undistorted reversals also may be transmitted. The TMG-3 is easily calibrated using the 60 Hz power supply as a frequency standard. The unit measures 5" x 7" x 4" and weighs 7 lb. Power requirement is 115 volts ±10%, 60 Hz, 20 watts. *Atlantic Research Circle 134 on Reader Service Coupon.*

Data Modems

The TE-216 series of data modems transmit and receive digital data at rates up to 4800 bps over voice frequency bandwidth telephone circuits via either wire line, cable, carrier or microwave. The three basic series are available in configurations for transmission at 4800, 3600 and 2400 bps. These modems are designed for continuous unattended operation. Transmission is full duplex (synchronous transmit and receive operation) over a 4-wire telephone circuit. The transmit function of the modem accepts serial digital data from an external source (computers, business machines), phase-amplitude modulates the data on the data tones, and applies the data tones to the telephone circuit. The receive function establishes synchronism with the pulse repetition rate of the signal received from the transmitting modem, demodulates and regenerates the data and provides the data in serial form to the associated input-output equipment. *Collins Radio Co. Circle 135 on Reader Service Coupon.*

● TELEPHONE carrier system, type LH1A, can provide 120 circuits on a coaxial cable. A description of the system including electrical specifications is provided in a 2-page brochure 15200-L-1. *Standard Telephone & Cables Ltd. Circle 136 on Reader Service Coupon.*

Train Length

The model 4080 train length computer counts the number of cars in a train and determines the length in feet of the train. A console provides readout in train length in number of feet and in number of cars in the train. The unit will work with train travel in either direction. The train length computer makes use of such information as

(Please turn to page 31)

Data Modem Characteristics

Prepared by Leo J. Ritter Staff Engineer, Communications & Signals, Penn Central. Reprinted by permission of George McCann, Secretary, Communication & Signal Section, AAR.

Manufacturer	Bell System	Collins Radio
Model	603D Data Set	TE-216-D-4D Modem
Transmit and/or receive	Transmit & receive	Transmit & receive
Full and/or Half Duplex	Half duplex	Full or half duplex
Dial up or Private Line Application	Dial up	Private line
Turn around time (HDX)	Not applicable	Depends on transmission path
Automatic answer capability	No	No
Type modulation	FM	Phase shift
Operating Frequencies	1700-2300 Hz	840-2460 Hz
Clock, internal or external	None	Internal or external
Loop back testing feature	No	Yes
Error rate	—	1×10^{-5} or better
Error detection and/or correction	—	None
EIA RS-232-B interface	No	No
Bit or character rate	Not applicable	2400 to 4200 bits/sec
Serial or parallel transmission	Serial	Serial or parallel
Impedance to line, ohms	Acoustically coupled	600
Impedance to data equipment, ohms	100,000	10,000
Voltages to and from data equipment	±2 volts	0 and +3 volts
Frequency stability	—	1 in 10^5 per day
Level stability	—	—
Output levels to line, dbm	Not applicable	−10 to +4
Input levels from line, dbm	Not applicable	−10 to 0
Line requirements, frequency response	Voice grade	±3 db, 900-2300 Hz to ±6 db, 400-2700 Hz
Line requirements, envelope delay	Voice grade	1.0 ms, 800-2350 Hz to 1.7 ms, 600-2700 Hz
Line requirements, impedance	Voice grade	600 ohms
Line requirements, signal to steady noise	Voice grade	20 db below RMS receive signal level
Line requirements, signal to impulse noise	Voice grade	10 db below RMS receive signal level
Method of operation	2 wire	4 wire
Temperature and humidity limits	—	0 to 52 deg C, 0 to 80%
Power requirements	Battery	117 volts
Dimensions and weight	9" x 13" x 4", 6 lb	8.75" x 17.5" x 22.5", 75 lb
Digital or analog	Analog	Digital

(Continued from page 29)

the time for successive carfronts to pass a second photoelectronic detector and the time for a car-front to travel a known 10 ft separation. This figure, of course, is updated for each car front. The length determination can be made at any speed of the train in excess of 5 mph. Because the reference is re-established for each intercar space, the train may change its speed without causing an appreciable error. *Erico Products Inc. Circle 137 on Reader Service Coupon.*

Teleprinter

The new VP-100 teleprinter is a receiving or way-page printer which has been designed for use in automobiles, locomotives or cabooses to provide written message output from VHF radio transmission. Transmission speed is at 100 wpm. *Motorola Communications & Electronics Inc. Circle 138 on Reader Service Coupon.*

Distortion Set

The DMS-3 equipment measures average bias and total distortion. This distortion measuring set can measure up to 11 different transmission speed settings, includes accurate loop-current measurement and is normally battery-operated. The DMS-3 is a short-pulse instrument which, when making bias measurements, the meter indication will follow changing signal conditions, permitting accurate adjustment of terminal equipment and teleprinter bias controls. The SIGS setting provides a means for observing the line condition, idle (marking), open (spacing), or incoming signals (alternating meter indication). The DMS-3 will handle speeds of 20 to 300 baud. The unit measures 3.5″ x 6.25″ x 3.625″ and weighs 2 lb. *Atlantic Research Circle 139 on Reader Service Coupon.*

Data Terminal

The DCT 2000 data communication terminal is a combination reader/punch and printer with associated control unit and operator's console. The reader/punch is rated at 200 cards per minute for reading and 75 cards per minute for punching. The printer is rated at 250 lines per minute. The printing throughout is essentially equal to the capacity of average voice-grade telephone lines. The DCT 2000 transmits synchronous data, block by block, at 2000 or 2400 bps under half duplex operation using ASCII code, format and procedure. The DCT 2000 is compatible with the EIA RS-232B standard communication interface. The DCT 2000 does not require programming and only minimal additional programming of the central computer is needed.

To send data and receive a reply contact is made with the operator at the central site by direct voice communication, or the computer sends a tone to the operator. The telephone set is then put on the "data" position and the "clear" and "transmit" buttons on the console are depressed. In a typical situation, the reader will read the cards until the card input-hopper is empty. The "out-of-cards" indicator designates that the card reader is finished transmitting, and the control unit will revert to the receive state and prepare to accept data. If the data is to be printed, it will be routed directly to the printer and one data block will be printed per line. *Univac Circle 140 on Reader Service Coupon.*

Solid-State Selector

The model 421-7 is an assembly of series 420 solid-state selector building blocks wired to operate and control a teleprinter station in a selective calling network conforming to the format of Western Union's plan 115B. The format is simplified by deleting the requirement for "address checking". That is, all transmission is to or from a central processor.

Option is available for external IBM to 5-level translator: The 421-7 is wired so that it can accept an interface card which allows it to switch signals to or from the translating device when selected. The unit requires 120 volts ±10%, power at 60 Hz, ⅜ amp. *Pulse Communications Inc. Circle 141 on Reader Service Coupon.*

DE Detector

A dragging equipment detector, model 4000, is now available and can also be equipped with a loose wheel detector (model 4000-10). Both units are bidirectional in operation and self-restoring. The dragging equipment detector portion is made up of separate panels which are self-restoring. The loose wheel detector feature, which is a vertical stainless steel unit with a detector head contact will respond at any train speed from 0 to more than 150 mph. *Erico Products Inc. Circle 142 on Reader Service Coupon.*

Selector

The model 431-1 solid state selector (except for logic and control relays) is designed primarily for use in selective calling systems using a computer, such as the Collins C8500. It may be adapted for use in other similar systems, such as Autocall, etc. The 431-1 is prewired to operate in a full duplex system, however, half-duplex operation is available as a strapping option. This selector responds to line signals of the 8-level start/stop sequential telegraph code and controls teleprinter equipment remotely on party line circuits. The power supply furnishes a +24 volt, +7 volts and +1.4 volts for operation of the transistor/integrated circuit logic and +60 volts for use with the selector magnet circuit. *Pulse Communications, Inc. Circle 143 on Reader Service Coupon.*

● DATA SET: The T201B data sets capable of operating at 2400 bps are described in bulletin 5309. These completely solid state, phase-modulated data modems transmit and receive serial binary data at a fixed synchronous rate over a private or leased voice grade communication channel. A technical summary and specifications are included. *Sangamo Electric Co. Circle 144 on Reader Service Coupon.*

● FACSIMILE: The Xerox Telecopier II is described in a brochure which gives operating information as well as specifications. The Telecopier II is a device for transmitting via facsimile over the conventional telephone circuits of 8½ x 11″ pages in approximately 6 minutes. *Xerox Corp. Circle 145 on Reader Service Coupon.*

● SIGNAL BATTERY: Section 35.01 provides specifications and application information on nickel-iron alkaline batteries for signal and communications service. A table of capacities, dimensions, and weights is also provided. *Exide Industrial Group, ESB Inc. Circle 146 on Reader Service Coupon.*

● COMMUNICATIONS: A short form catalog, GC-1, issue 2, provides a description and listing of the products and services covering microwave, radio multiplex, trunk carrier, subscriber carrier, telegraph and data transmission, supervisory and control systems, auxiliary and test equipment and customer services. *Lenkurt Electric Co., Inc. Circle 147 on Reader Service Coupon.*

● BLOCK SIGNAL CONTROLS are described in bulletin M2001 (9-68) using pulse modulated control techniques. This system permits transmission of signal codes through rails in audio frequency carriers, thus eliminating line wires and insulated joints, except at home signals, crossovers and sidings. *Marquardt Industrial Products Co. Circle 148 on Reader Service Coupon.*

● RADIO known as the Personalfone is a two-way hand-held FM unit. It is available in the 132-174 mHz frequency range. Descriptions, photographs and electrical specifications are provided in form 3J5283. *RCA Mobile Communications. Circle 149 on Reader Service Coupon.*

● ANTENNAS for microwave systems are featured in catalog MW 168. In addition to descriptions, photographs and electrical characteristics, shipping information and other pertinent data for microwave antennas serving the 1.7–8.3 GHz frequency ranges are included. *Decibel Products Inc. Circle 150 on Reader Service Coupon.*

● TOOLS are described in a new catalog #200A. Featured are precision hand tools for telephone, relays, radio and other communications equipment maintenance and repair. Drawings showing dimensions and specifications of tools are included in the catalog. *Jonard Industries Corp. Circle 151 on Reader Service Coupon.*

● TEST INSTRUMENTS are described in bulletin 368A. The catalog has prices and specifications of solid-state digital equipment, including a volt-ohm-milliammeter and a new electric counter which is ± 0.01% accurate up to 20 mHz. *Simpson Electric Co. Circle 152 on Reader Service Coupon.*

Data Modem Characteristics

Prepared by Leo J. Ritter Staff Engineer, Communications & Signals, Penn Central. Reprinted by permission of George McCann, Secretary, Communication & Signal Section, AAR.

Manufacturer	Collins Radio	Collins Radio
Model	TE-216A-2D Modem	TE-216A-3D Modem
Transmit and/or receive	Transmit & receive	Transmit & receive
Full and/or Half Duplex	Full duplex	Full duplex
Dial up or Private Line Application	Private line	Private line
Turn around time (HDX)	—	—
Automatic answer capability	No	No
Type modulation	Phase shift plus AM	Phase shift plus AM
Operating Frequencies	1500 & 2000 Hz	1250, 1750 & 2250 Hz
Clock, internal or external	Internal	Internal
Loop back testing feature	Yes	Yes
Error rate	1 in 10^5, 18 db SNR	1 in 10^5, 19.5 db SNR
Error detection and/or correction	None	None
EIA RS-232-B interface	Yes	Yes
Bit or character rate	2400 bits/sec	3600 bits/sec
Serial or parallel transmission	Serial	Serial
Impedance to line, ohms	600	600
Impedance to data equipment, ohms	RS-232-B	RS-232-B
Voltages to and from data equipment	RS-232-B	RS-232-B
Frequency stability	1 in 10^4	1 in 10^4
Level stability	±1.5 db	±1.5 db
Output levels to line, dbm	−15 to 0	−15 to 0
Input levels from line, dbm	−30 to +5	−30 to +5
Line requirements, frequency response	4B voice	4B voice
Line requirements, envelope delay	4B voice	4B voice
Line requirements, impedance	540-600 ohms, 300-3200 Hz	540-600 ohms, 300-3200 Hz
Line requirements, signal to steady noise	18 db	19.5 db
Line requirements, signal to impulse noise	—	—
Method of operation	4 wire	4 wire
Temperature and humidity limits	0 to 50 deg C, 95%	0 to 50 deg C, 95%
Power requirements	200 watts	250 watts
Dimensions and weight	9" x 22" x 17", 72 lb	9" x 22" x 17", 72 lb
Digital or analog	Digital	Digital

NEWS BRIEFS

(Continued from page 8)

● PENN CENTRAL has ordered a Class-Matic II freight terminal control and information system from General Railway Signal Co. for installation at a 40-track yard at Columbus, Ohio, In this system, a high-speed, general process control digital computer will log and route inbound trains onto the various class tracks. A standby central processing unit will provide back-up control. Also to be supplied will be supervisory control and display units, computer interface, radar speed control, distance-to-coupling control, electrically operated car retarders, electric switch machines with solid-state detectors to protect against unsafe operations and transistorized radio controlled cab signals.

● PORT AUTHORITY TRANS-HUDSON CORP. has awarded a $1,379,893 contract to the Signal & Communications division of WABCO for the design, supply of equipment and installation of the interlocking and signal facilities to govern train movements at its new 5-track terminal beneath the World Trade Center in downtown Manhattan in New York City. Included will be an automatic train dispatcher system to permit sequential dispatching on a pre-arranged program.

PATH board of directors have authorized a $730,000 project to install a two-way radio system to permit direct communications between its operation control center and crews on trains. The new radio system, using two assigned channels in the railroad VHF band, will have train-carried radios, special antenna wires strung through all tunnels, and special base stations to collect radio transmissions via the tunnel antennas. Leased telephone circuits will connect the operations control center with these base stations. Police and maintenance personnel will carry portable radios.

● SANTA FE will complete its microwave installation this year between Riverdale, Kan. and Silsbee, Tex. Part of the field installations for the road's computer controlled message switching system is to provide for more than 200 circuits and installation of 500 teletypewriters. New dial phone exchanges will be installed at two locations during 1969. Also, AT&SF and MP will install CTC on a 26-mile, single-track, jointly operated line between Nepesta and Pueblo Jct., Colo. Between Summit and Barstow, Calif., the 25 Hz signal system will be replaced with 60 Hz power and battery standby. During 1969, the road will install additional hotbox detectors, automatic protection at rail-highway grade crossings and ACI scanners.

During 1968, AT&SF completed 45 flashing-light and 63 automatic gate crossing installations at highways. The road installed 5 hotbox detectors and 131 radios.

● SOUTHERN PACIFIC's petition for discontinuance of automatic train stop systems between Oakland and Pittsburg, Calif., 43 miles and between Gold Run and Truckee, Calif., 54 miles, has been reviewed by Federal Railroad Administrator A. Scheffer Lang. He issued a decision and order as follows:

The examiner found that the particular type of train stop system in use on the petitioner's lines does not provide the measure of safety which should be required of a train stop device, that the device fails unsafe, that it does not further safety, and that the petition should be granted. Exceptions were filed by the protestants. They have been considered and found without merit.

While I agree with the examiner's findings and with his ultimate conclusion that approval should be granted to discontinue the particular devices here under consideration, I am not persuaded that this proceeding should terminate with the granting of approval to remove the train stop devices now present on petitioner's lines. In the light of the broad safety responsibilities of the Federal Railroad Administration under the Signal Inspection Act (49 U.S.C. 26(B)), something more than the discontinuance of inadequate devices should also be considered. I find that the record here supports the finding that the present devices may be discontinued, but that it does not contain sufficient information to determine whether additional safeguards are needed to assure safety of operations between the involved points, particularly those in the High Sierras.

Accordingly, it is ordered that this matter be set for further hearing to develop the information needed to make this determination. In addition, the petition of the Southern Pacific to discontinue the automatic train stop system (1) between Shellmound (Oakland), MP 7.07, and Martinez-Bahia, Calif., MP 35.72, (2) between Martinez, MP 34.78, and Pittsburg, Calif., MP 50.3, and (3) between Gold Run, MP 153.47, and Truckee, Calif., MP 207.54, all as more specifically set forth in the petition is hereby granted, subject, however, to whatever conditions other than retention of the present automatic train stop devices, that I determine, after further hearing in this proceeding, to be necessary to assure safety of operation.

Railroad Personnel

● CHESAPEAKE & OHIO/BALTIMORE & OHIO: **Joseph R. Bellomy** assistant communications inspector appointed asst. communications engineer. **Paul L. Wheeler,** asst. signal engineer appointed signal engineer. **Gary J. Bowerman,** signal application engineer, appointed junior circuit engineer. **Hugh L. DeMoss,** assistant signalman, appointed signal application engineer. All the above men are headquartered in Huntington, W. Va. **Thomas E. Dodds,** assistant supervisor signals, Walkerton, Ind., transferred to Akron, Ohio. **Lawrence Hanlon, Jr.** appointed assistant supervisor signals at Walkerton, Ind. **Robert G. Mynhier,** assistant supervisor signals, Akron, Ohio appointed signal supervisor at Connellsville, Pa. **Earl E. Jones,** signal maintainer, Athens, Ohio, appointed assistant supervisor signals at Hamilton, Ohio.

Mr. Wheeler was born on April 23, 1926 in Ashland, Ky. After education at the University of Kentucky and service in the U.S. Army, he began his railway career with the C&O in 1944 as an assistant signalman. He advanced through various positions becoming assistant signal engineer in 1960, his latest position prior to his recent promotion.

Paul L. Wheeler
C&O/B&O

George Pipas
Illinois Central

● CHICAGO, SOUTH SHORE & SOUTH BEND: **Charles F. Mulrenan,** signal and electrical engineer, promoted to assistant chief engineer.

● COMMUNICATION & SIGNAL SECTION, AAR: New members of the Committee of Direction include D. C. Hill, NP, and W. B. Van Lear, N&W. They replace **L. S. Bottinelli,** PC, retired, and **R. M. Laurenson,** St. L-SF, who will retire April 1, 1969. CofD membership includes **A. S. Walker,** general inside plant engineer, telecommunications department, Canadian Pacific; **R. D. Liggett,** chief engineer, communications & signals, Seaboard Coast Line and second vice-chairman of the C&S Section; **V. S, Mitchell,** signal engineer, Chicago & North Western; **K. M. Lockerby,** director communications & signals, Penn Central; **George Pipas,** director communications and computer services, Illinois Central; **D. C. Hill,** superintendent of communications, Northern Pacific; **H. R. Beck,** assistant chief engineer-administration, Canadian National, and chairman C&S Section; **W. B. Van Lear,** manager, signals & communications, Norfolk & Western; **J. N. Albertson,** general superintendent communications- system, Southern Pacific, and first vice-chairman C&S Section; **E. A. Burgin,** superintendent of signals, Chesapeake & Ohio/Baltimore & Ohio; **C. O. Jett,** superintendent of communications, Union Pacific; and **C. J. Nelson,** general superintendent communications & signals, Chicago, Rock Island & Pacific.

● ILLINOIS CENTRAL: **George Pipas,** director of communications, appointed director communications and computer services, succeeding **Richard P. DeCamera,** vice-president, information and control systems department. Mr. DeCamera has been appointed vice-president, administration and will retain general jurisdiction over the renamed department of communications and computer services. **William H. Thompson,** director of data control, promoted to vice-president operations and general manager. **James C. Taylor,** engineer of communications, promoted to director of communications.

Mr. Pipas was born April 17, 1922 in Nokomis, Ill. Following graduation from

(Please turn to page 34)

NEWS BRIEFS

(Continued from page 33)

the University of Illinois with a bachelor of science degree in electrical engineering in 1946, he joined IC as an engineering aide in the signal department. He advanced through various positions becoming field signal engineer in 1951, and special engineer in 1953. Three years later, Mr. Pipas was promoted to signal engineer, and in 1964 appointed general superintendent communications & signals. He was appointed director of communications in 1967.

● KANSAS CITY SOUTHERN: **Roy L. Fitzmeyer** appointed manager of signals and communications. **L. D. Fry**, superintendent of communications, has retired.

● PENN CENTRAL: **Louis S. Bottinelli,** engineer communications & signals, has retired. He was born in New York City on June 14, 1906 and began his railway career with the New York Central in 1925 and advanced through various positions becoming assistant circuit engineer in 1942. In 1949 he was appointed assistant engineer, electric division and four years later promoted to system chief signal inspector. In 1955, Mr. Bottinelli was appointed assistant chief signal engineer and in 1958 to chief signal engineer system. Mr. Bottinelli was appointed engineer communications & signals, NYC in 1965, and held the same position when NYC merged with the Pennsylvania in 1968.

● SOUTHERN: **Carl T. Steelman, Jr.,** management trainee, appointed supervisor communications at Chattanooga, Tenn. **N. Eugene Singleton** appointed electronic engineer, signal & electrical at Atlanta, Ga.

Supply Trade News

● ABEX Corp.: **Robert N. Post,** product manager for railroad trackwork at Mahwah, N.J., appointed eastern regional sales manager with headquarters in Philadelphia, Pa.

● CARDION COMMUNICATIONS: **Parker W. Knight** has been appointed president. He was formerly manager of guidance and control systems for General Electric Co. at Syracuse, N.Y. He was with GE for more than 18 years. Mr. Knight has a bachelor of science degree in electrical engineering from Syracuse University.

Michael Seranne
Gen. Ry Signal

Edward Riley
Lynch Comm.

Donald W. Wessels
Sylvania Elec.

C. B. Ramsdell
S&C div. WABCO

● COMPUTER IDENTICS CORP.: **Dr. Robert H. Gregory** and **Chris B. Kapsambelis,** formerly with Sylvania Electric Products Inc., and having worked on the KarTrak automatic car identification system, are now associated with **David J. Collins** president (See RS&C Jan. 1969, page 37).

● THOMAS A. EDISON INDUSTRIES, Primary Battery Division: **James D. Greer,** field engineer, has been appointed assistant southwestern regional manager with headquarters at 2074 Railway Exchange Building, St. Louis, Mo. Mr. Greer was born on July 1, 1927 in Marshfield, Mo. He joined St. Louis-San Francisco in 1944 as a signal helper and advanced through various positions to that of test foreman. He joined Edison in 1961 as a service engineer and was promoted to field engineer in 1965.

● GENERAL ELECTRIC CO.: **Norman W. Seip,** manager transportation equipment projects and marketing operation, apppointed general manager of the newly formed transit systems department. This new department designs, builds, and markets automation, propulsion and braking systems for rapid transit and high-speed intercity rail transportation. This department also designs and builds rail automation systems for application to railroad classification yards and locomotive speed control.

Mr. Seip, a native of Chicago, Ill., graduated from the University of Illinois with a bachelor of science degree in mechanical engineering in 1940. He joined GE in 1940, and was appointed transportation sales engineer in 1945 at St. Louis. He was appointed manager, parts sales in the locomotive and car equipment department in 1950. After serving in advertising, sales promotion and marketing functions he was named manager transportation equipment projects and marketing operation in 1965.

Glenn R. Petersen, manager of the mobile radio business section, has been appointed general manager of the newly formed mobile radio department. A native of Milwaukee, Wis., Mr. Petersen received his electrical engineering degree from the University of Wisconsin. He joined GE in 1950 in the apparatus sales division and four years later joined the sales organization of the specialty control department. Subsequently he was appointed manager of machinery automation control and joined the communication products department in 1960. Later he was appointed marketing manager of the communications products department.

Earl W. Russell, major accounts manager for military and OEM sales, communications products department, appointed regional manager of telecommunications systems sales heading the northeastern sales region with offices at Washington, D.C.

● GENERAL RAILWAY SIGNAL CO.: **Michael Seranne,** formerly field service manager, Servo Corp. of America, appointed product engineer- train detection. A native of Marseilles, France, he received a bachelor of science degree at the Lycee Carnot in Tunisia.

● GRAYBAR ELECTRIC CO.: W. K. **Collum** appointed district manager at Philadelphia, Pa., succeeding **W. J. Goerisch,** retired. The following district sales managers have been appointed: **J. D. Brown** at Philadelphia; **F. B. Murray** at Dallas; and **E. N. Cundiff** at Cleveland. Newly appointed branch managers include **B. N. Jarrell** at San Antonio, Texas; **G. W. Ostrander** at Garden City, N.Y.; **A. R. Tierney** at West Hartford, Conn.; **J. N. Everetts** at Canton, Ohio; and **G. W. Freeman** at Peoria, Ill., succeeding **W. W. Smilde,** retired **J. E. Ward** appointed manager at the new Fort Wayne, Ind., branch.

● LYNCH COMMUNICATION SYSTEMS: **Edward Riley** appointed communications engineer with headquarters in Atlanta, Ga. Prior to joining Lynch, he had been employed in the telephone industry for over 16 years with firms such as Western Electric Co., Lenkurt Electric Co., Inc., and Trans-American Communications Inc.

Norman W. Seip
General Electric

G. R. Petersen
General Electric

Parker W. Knight
Cardion Comms.

James D. Greer
T. A. Edison

Charles F. Wert
S&C div. WABCO

G. E. Stinson
S&C div. WABCO

● POWER CONVERSION PRODUCTS INC. appointed Long Supply Co., Franklin Park, Ill., as its sales agent to railroads in the St. Paul-Minneapolis, Minn. area and to certain railroads in Chicago and the West.

Herbert Watkins, formerly of Modern Industries, Inc., has joined Long Supply Co. PCP, successor to the rectifier products division of Fansteel, Inc., began operation Jan. 6, 1969 at 42 East St., Crystal Lake, Ill. 60014.

● STROMBERG-CARLSON CORP. has come to an agreement in principle whereby Continental Telephone Corp. will sell its manufacturing subsidiary Superior-Continental Corp. to S-C.

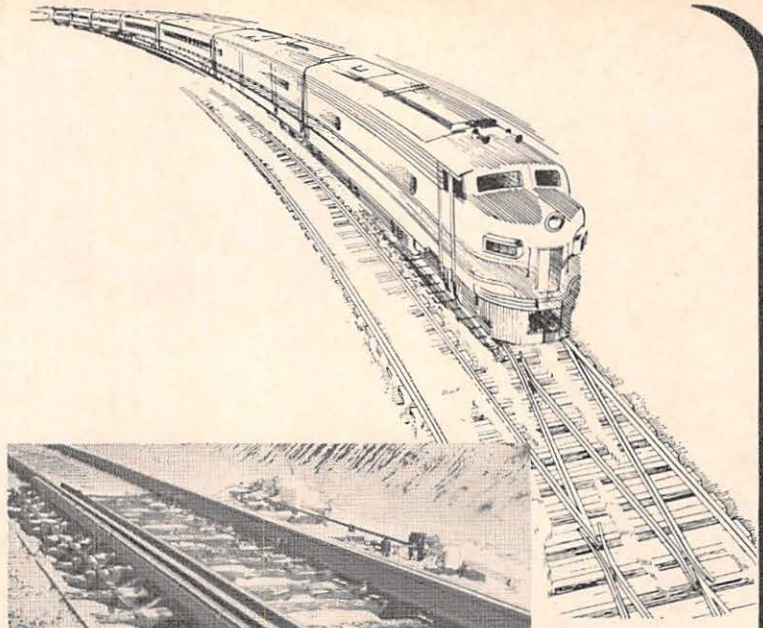
● SYLVANIA ELECTRIC PRODUCTS INC.: **Donald W. Wessels,** formerly manager of railroad sales for Fairbanks-Morse weighing systems, appointed midwestern regional manager-railroad sales for the commercial electronics division. He will be responsible for sales of the Kar-Trak automatic car identification systems and will be headquartered at 2001 North Cornell Ave., Melrose, Park, Ill. 60160. From 1957 to 1966, Mr. Wessels was with the Streeter-Amet division of Mangood Mfg. Co.

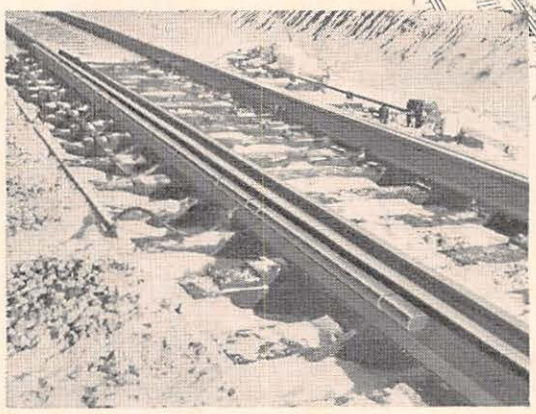
● U.S. UNDERSEAS CABLE CORP. in conjunction with Phelps Dodge and Felten & Guilleaume Carlswerk AG have formed a new Land Communications Systems Division. The new division will engineer, produce and install land cable systems for transmission of telecommunications, video and data.

● SIGNAL & COMMUNICATIONS DIVISION, WABCO: **Charles F. Wert,** manager- railway and industrial sales, appointed manager-marketing. **Glenn E. Stinson,** manager, southwestern region at St. Louis, appointed manager-railway and industrial sales. **Leland G. Phillips,** sales engineer, Chicago, appointed manager-southwestern region. **Robert M. Karow,** market development manager for ACI appointed manager, customer service and order planning.

C. Benjamin Ramsdell, vice-president of WABCO and general manager S&C division (see Dec. 1968 RS&C page 11) holds a BSEE degree from Catholic University in Washington, D.C. Prior to joining WABCO in 1964 as manager- mass transit, Mr. Ramsdell had been with GE for 24 years in the areas of engineering, marketing and management, including general man-

(Please turn to page 36)





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Circle 10 on reader service card on page 38

(Continued from page 35)

ager of commercial and industrial air conditioning. In 1965, he was appointed vice president, marketing, his last position prior to his recent promotion.

Mr. Wert graduated from Drexel Institute of Technology in 1941 with a degree in electrical engineering. He joined WABCO's S&C division in 1953 as a sales engineer in New York. In 1962, he was appointed assistant district manager there and promoted to district manager in July 1962. In 1964, he was appointed manager-railway sales.

Mr. Stinson joined the Rock Island as a signal maintainer and was appointed circuit engineer in 1947. He joined the S&C division as an application engineer in 1956. Three years later he was appointed sales engineer and in 1965 was appointed assistant district manager at Chicago. He was appointed manager of the southwestern region at St. Louis in 1966.

Mr. Phillips began his signaling career with the Milwaukee Road in 1946 as a signal maintainer at Laredo, Mo. In 1955 he was promoted to signal draftsman at Chicago, and later became assistant engineer signals. In 1957 he was promoted to signal inspector. He joined Union Switch & Signal in 1961 as sales engineer in Chicago.

Mr. Karow began his signal career in the signal department of the Chicago & North Western. He received an electrical engineering degree from the University of

Leland G. Phillips
S&C div. WABCO

Robert M. Karow
S&C div. WABCO

Frank J. Cullen
Western-Cullen

D. D. Christensen
Western-Cullen

Wisconsin in 1953 and joined WABCO the same year as an application engineer. He advanced through various positions of project and sales engineering, and prior to his recent promotion was market development manager for automatic car identification equipment.

● WESTERN-CULLEN DIVISION of Federal Sign & Signal Corp.: **Frank J. Cullen,** vice-president marketing, appointed vice-president FS&S and manager of the W-C division, succeeding **George L. Hudson,** who has resigned but will continue to serve as a consultant. Mr. Cullen received a mechanical engineering degree from Notre Dame University, and joined Cullen Friestetd as a sales engineer in 1959. Western Cullen division was formed when FS&S acquired both Western Industries (also Western Railroad Supply Co.) and Cullen-Friestetd Co. Mr. Cullen was president of C-F, and Mr. Hudson was president and chairman of WI. Mr. Hudson, formerly sales manager, Enterprise Railway Equipment Co., joined WI in 1954 as executive vice-president. In 1955, he was elected president and a year later made chairman, board of directors.

Dean D. Christensen, signal maintainer. Baltimore & Ohio, South Chicago, Ill., appointed assistant signal engineer with headquarters in Chicago. Mr. Christensen joined B&O in 1963 as assistant signalman at Walkerton, Ind. During the next two years he worked on CTC installations and was promoted to signalman. In 1965, he was made signal maintainer at South Chicago, and later worked on installing crossing protection on the Akron-Chicago division. Prior to returning to the signal maintainer's position at South Chicago, he was briefly signal maintainer at the Willard, Ohio classification yard.

● WESTERN UNION's board of directors approved agreements for the pur-

(Please turn to page 38)

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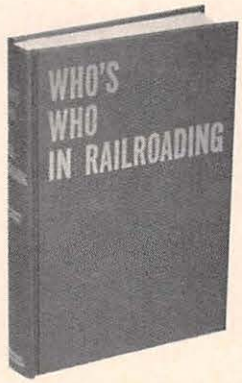

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Advertiser's Index

Carbone Corporation, Primary Battery Division, The.. 4

Edison Industries, Primary Battery Div., McGraw-Edison Co., Thomas A. .....IBC

General Railway Signal Company 21

Hayes Track Appliance Company 37

Joslyn Electronic Systems, Div. of Joslyn Mfg. and Supply Co. 6

Kerite Company, The .....FC

Nife Incorporated 10

RACO (Railroad Accessories Corp.) .....IFC
Rails Company, The 35
RCA Electronic Components and Devices 3

Servo Corporation of America 7
Star Headlight & Lantern Company 37
Stromberg-Carlson 9

Western/Cullen Div., Federal Sign and Signal .....BC

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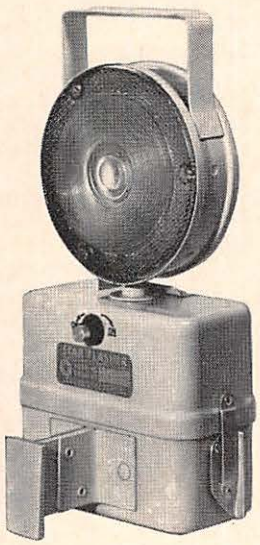

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Circle 12 on reader service card on page 38

NEWS BRIEFS

(Continued from page 36)

chase by WU of the Bell System's Teletypewriter Exchange (TWX) Service. AT&T's board of directors also approved in principle the terms of the agreement.

The estimated price of the service and the associated equipment Western Union will acquire from the Bell System is about $80 million. Western Union has the option of paying up to one-half of the purchase price in the form of four-year promissory notes. The remainder would be paid in cash when the transaction is closed.

The agreements are subject to approval by the boards of the Associated Bell telephone companies, expected to act shortly, and other preliminary conditions, including negotiation of arrangements with other carriers and regulatory approvals. Closing of the transaction may not take place for 18 months or more in view of necessary studies and approvals, and the need to negotiate appropriate arrangements with connecting carriers.

TWX is the Bell System's Teletypewriter Exchange Service, which AT&T inaugurated in 1931. A TWX subscriber, by dialing, can establish a direct machine-to-machine connection with any other subscriber for the exchange of typewritten communications. The service is provided by the Bell System in the areas it serves, and is available from independent telephone companies in the United States and, in Canada, from the Bell Telephone Company of Canada.

The Bell System companies have about 40,000 teletypewriter machines in customer TWX service, with revenues of approximately $72 million annually.

Telex is Western Union's teleprinter exchange service which competes with TWX. Western Union introduced Telex service in the United States in 1958. Today there are more than 26,000 Telex subscribers, and revenues are running at an annual rate of approximately $41 million.

Subscribers to Western Union Telex dial connections with other subscribers in the United States, Canada and Mexico, and use directly connected machines to exchange messages. By dialing one of the international record communications companies, a subscriber in the country can communicate directly with more than 200,000 Telex subscribers in 130 other countries throughout the world. In addition, subscribers to Telex can dial a Western Union computer to obtain special automatic services which add greatly to the flexibility of the basic exchange service.

An exclusive feature of Western Union Telex is Tel (T) ex. Every subscriber may send Tel (T) ex messages to non-subscribers in major cities in the United States and Canada by transmitting them to the central telegraph offices in those cities. The messages are then delivered as telegrams.

Western Union is in the business of providing record communication services, and TWX is very much that kind of service. The acquisition of TWX will permit Western Union to combine it with Telex service in a unified telegram exchange service offering subscribers the benefits of a substantially broadened scope of service and of new computer-controlled services of the kind recently introduced by Western Union for Telex subscribers.

It will also speed Western Union's program to build a single, integrated system to serve all types of customer's, from those who send occasional telegrams to those with a constant requirement for high-speed transmission of data between computers. An integrated computer-based system offers the advantages of improved service, increased reliability, operating flexibility and lower costs—and, most important, the means of introducing new services.

The Merger Act, passed by Congress in 1943, provided for the merger of Western Union and Postal Telegraph. This merger act also included a provision which permitted the merged company "to acquire the domestic telegraph properties, domestic telegraph facilities or domestic telegraph operations of any carrier which is not primarily a telegraph carrier." Discussions were initiated between AT&T and Western Union looking toward the purchase by Western Union of AT&T's TWX service. AT&T made an offer to sell the service on May 5, 1943 and negotiations on this subject proceeded for more than two years.

Late in 1945 the operating costs of Western Union were materially increased and its accumulated financial reserves practically wiped out by then current and retroactive wage increases imposed by the War Labor Board. It became impossible, at least at that time, for Western Union to acquire TWX.

The discussions and negotiations which led to the purchase agreements just announced began in 1964, and continued with only two brief interruptions, the first in late 1964 and the second in mid-1968.

The FCC's Telephone and Telegraph Committees, late in 1966, recommended the acquisition of TWX by Western Union as a step in creating an "integrated record message service".

The negotiations leading to the announced agreements were between AT&T and Western Union. Western Union will apply for FCC approval. While approval cannot be presumed, it would be consistent with the FCC's Telephone and Telegraph Committees' recommendations.

Western Union is buying TWX as a going business; and the purchase price will reflect the agreed upon value of that business. The hardware scheduled to change hands consists principally of teleprinters located on the premises of TWX subscribers, plus some Bell System central office equipment used exclusively to provide TWX service.

The TWX system, as presently operated by the Telephone company, utilizes circuitry and switching gear in the Bell System's regular telephone plant. Under the terms of an operating agreement concluded with the purchase agreement, Bell System telephone companies will continue to lease this circuitry and switching gear to Western Union, as required.

Western Union is not buying the teletypewriter machines used by Bell System customers of Data-Phone Service. As part of the agreement reached, however, the telephone company will not, for a period of five years from the purchase closing, offer additional teletypewriters to operate at speeds below 300 bits per second, or from 300 to 400 words per minute, for use with Data-Phone Service. Teletypewriters used in TWX Service operate at speeds of 100 words a minute, or less.

Also not included in the sale are teletypewriter machines used by the Bell System companies to provide private line teletypewriter services.

The tentative and approximate intervals in the timetable are: Four to six months to complete an inventory of TWX equipment to be purchased by Western Union, and prepare a preliminary estimate of the purchase price; two months to prepare and submit material to the FCC for approval; several months for F.C.C. consideration; up to five months to update the inventory of TWX equipment and arrive at a final purchase price; and about three more months to the purchase closing between AT&T and Western Union, and the transfer of TWX service. These steps will probably require 18 months or longer to complete.

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47	48	49	50	51	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
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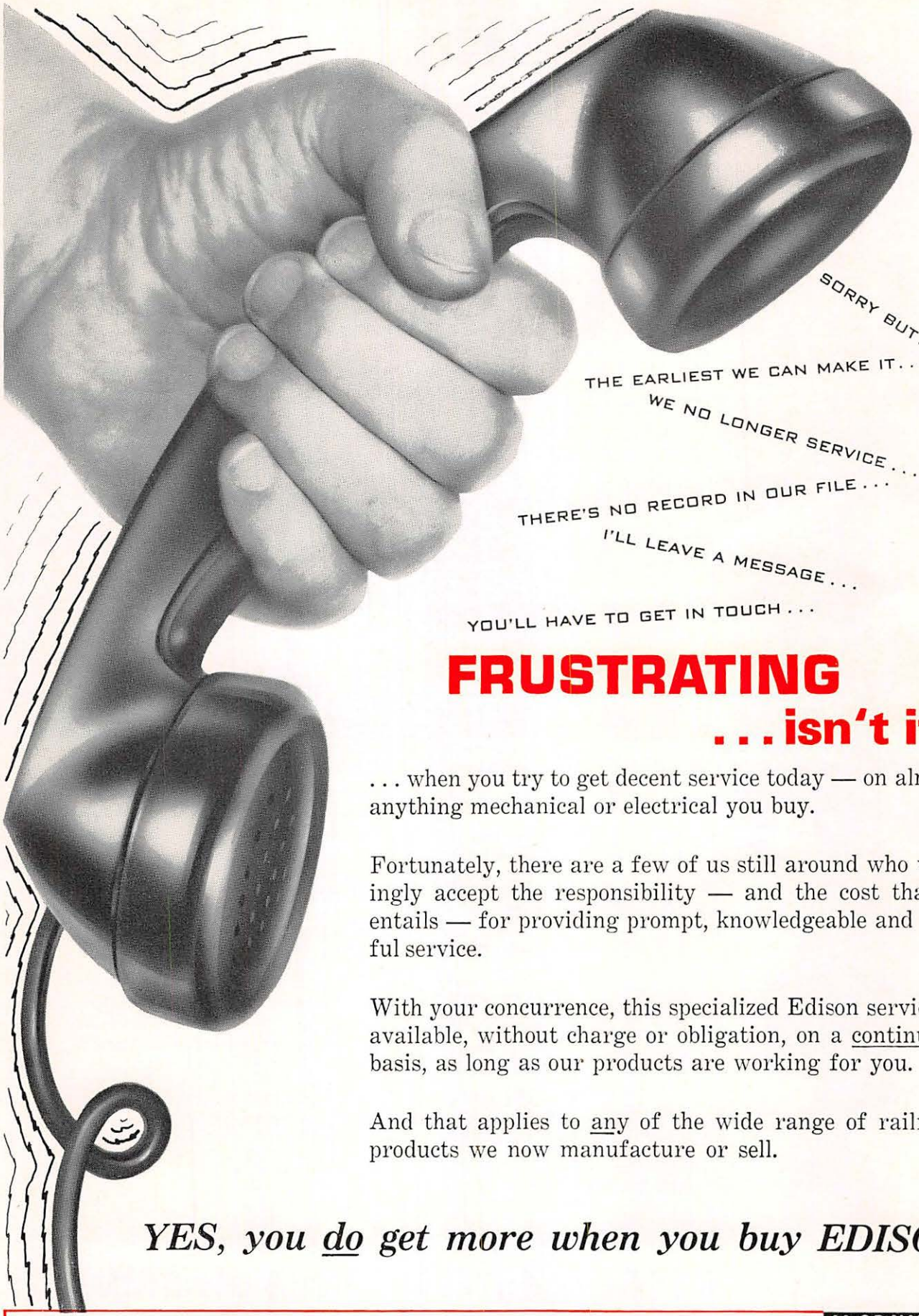
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